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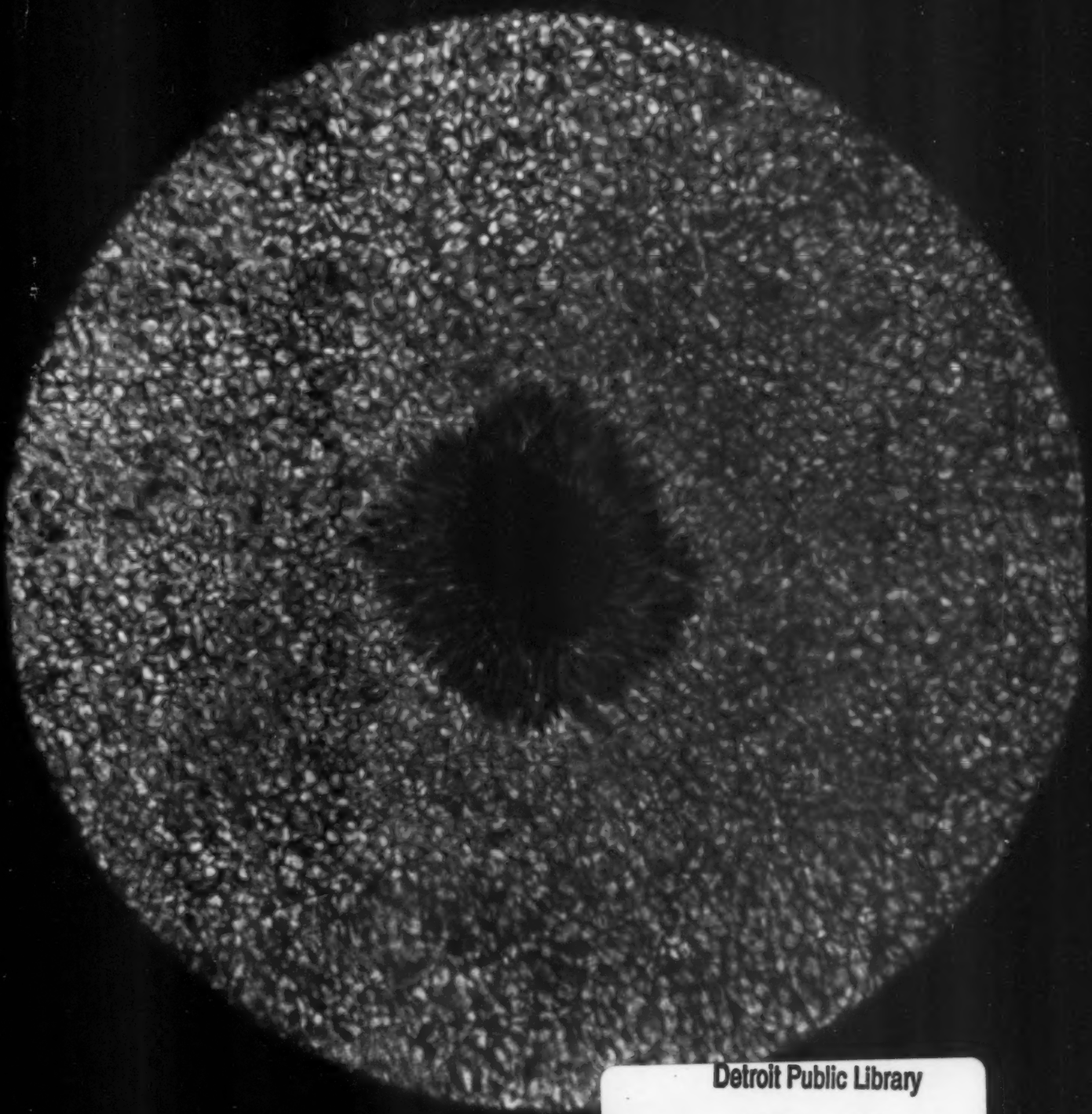
Mariners Weather Log

Summer 1995



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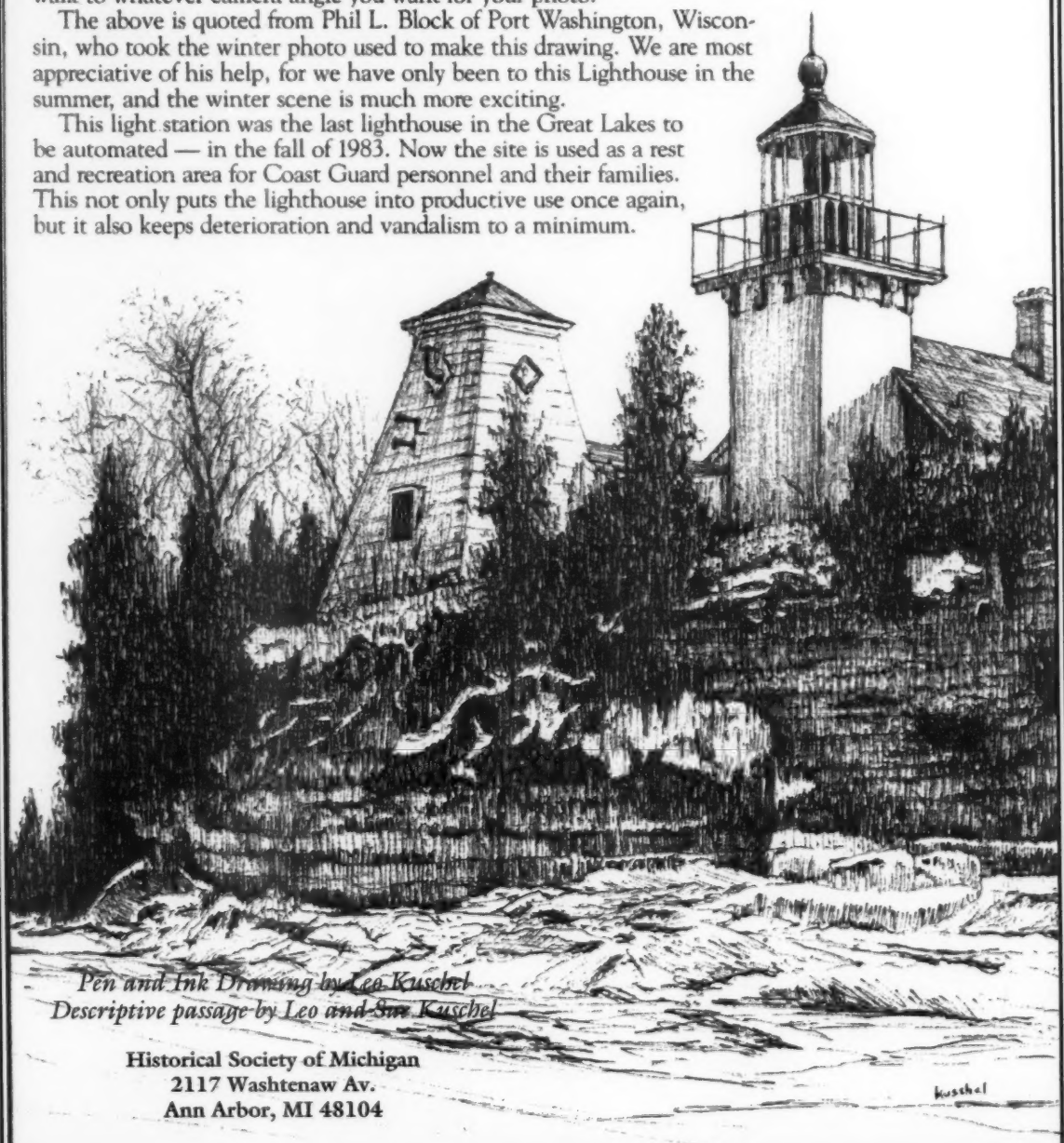
Sherwood Point Lighthouse

Lake Michigan
Sturgeon Bay, Wisconsin

"There is a nice staircase descending the 40 feet or so of bluff. Footing on the steps is treacherous, but with care it is easy to get down to the frozen surface of the bay. From there, it is a simple matter to walk to whatever camera angle you want for your photo."

The above is quoted from Phil L. Block of Port Washington, Wisconsin, who took the winter photo used to make this drawing. We are most appreciative of his help, for we have only been to this Lighthouse in the summer, and the winter scene is much more exciting.

This light station was the last lighthouse in the Great Lakes to be automated — in the fall of 1983. Now the site is used as a rest and recreation area for Coast Guard personnel and their families. This not only puts the lighthouse into productive use once again, but it also keeps deterioration and vandalism to a minimum.



Pen and Ink Drawing by Leo Kuschel
Descriptive passage by Leo and Sue Kuschel

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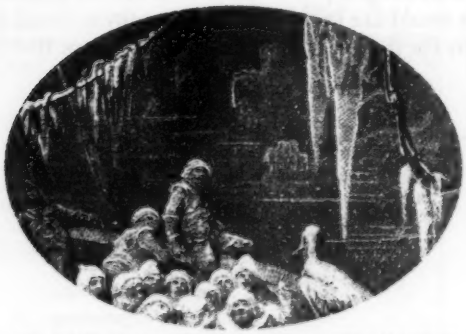

*Dorés' illustration from the **Rime of the Ancient Mariner** is apropos to Lifelines— page 34*

Cover: High angular resolution of a large sunspot image obtained at NSO/SP from a vacuum tower telescope in Sunspot, New Mexico. Courtesy of National Solar Observatory/Sacramento Peak.

Back Cover: Tolchester Beach across the Chesapeake Bay from Baltimore, Maryland was a favorite resort at the turn of this century. This photograph is from the collections of the Mariners' Museum, Newport News, Virginia.

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The Secretary of Commerce has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Director of the Office of Management and Budget through July 1, 1995.

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Articles, photographs and letters should be sent to:

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1825 Conn. Av., NW
Washington DC 20235.

Requiem for the *Log*

As we go to press all indications are this will be the last issue of the *Mariners Weather Log*. Since 1957 the *Log* has provided marine weather information to the mariner as well as many others in the maritime community. It has been a pleasure to serve an audience who has always appreciated our efforts and often said so in writing or by phone. We have felt and it has generally been acknowledged that the Log has been an effective method of encouraging the taking of weather observations worldwide and informing mariners and others of just how those observations are used in real time and in research.

At the very least there will be a break in the continuity of issues as options for continuing the publication are explored. There are a number of possibilities and we are hopeful that the magazine will be revived in the future.

We hope that the demise of the *Mariners Weather Log* will not affect the number of observations taken at sea. The Marine Weather forecasters and the National Climatic Data Center are very much dependent on the observations provided by the merchant mariner as well as the U.S. Coast Guard and the other military services. Both have also been very supportive of the *Log*.

The *Log* has had a good run. We hope that it has been entertaining as well as informative. We have been able to provide data that was either not available anywhere else or was very hard to come by. Even though we were always a small operation, we had outstanding support both in the United States and abroad. The unselfish contributions of so many people and their willingness to go the extra mile is in the main what gave us the success that we did enjoy.

We have faced similar crises in the past and our supporters have made their feelings known. We are still trying to keep things going and feel that the *Log* is an integral part of the overall marine voluntary observing program. We would like to take this opportunity to thank those in the marine community for their support in the past and hope that we may return.

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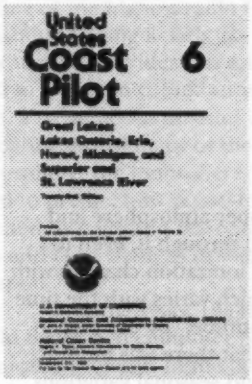

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SOLAR CYCLE EFFECTS ON WEATHER FACSIMILE SIGNALS

Dr. Robert R. Brown
Anacortes, Washington

The Ancient Mariner used his "weather eye" to scan the sky, from horizon to horizon, and placed what was visible up against years of experience to come up with a forecast of sailing conditions. The Modern Mariner's "weather eye" is now at satellite altitude and forecasts and observations reach the Mariner by radio, operating either in the HF or VHF range.

HF weather facsimile (WEFAX) transmissions and their reception depend on solar conditions, slowly varying over solar cycles or changing more rapidly when solar flares and storms erupt. That may seem like a prescription for chaos, but solar conditions may be anticipated and dealt with in a manner which will restore faith to some who have been disappointed by HF WEFAX in recent times.

RADIO PROPAGATION

The sun ionizes the upper atmosphere and radio waves may be propagated through it, even to great distances. The degree of ionization changes with the amount of illumination, which varies with the time of day, season or geographic latitude. By the early 1930s, it was well understood that there was more to the matter than just the daily and seasonal variations of solar illumination. The degree of ionization, and the propagation of radio waves, proved to be influenced by the source strength, the amount of solar radiation in the ultra-violet range. It became apparent that

Robert R. Brown is a Emeritus Professor of Physics, Berkeley Campus, University of California. Before retiring, Dr. Brown's research specialty was solar-terrestrial interactions and ionospheric and radiation disturbances at auroral and polar latitudes. He has written on HF propagation for a number of amateur radio magazines in the USA and Canada and presently resides on Guemes Island, across from Anacortes, WA.

solar ionizing radiation and the radio propagation which results vary with the number of active regions, i.e., sunspots, on the solar disk.

The counting of sunspots has been an honorable calling, going back to 1750. Now, the data taken from daily records across the globe are adjusted for "seeing" and averaged to give a single value, sunspot number (SSN), a measure of solar activity for a given month. Such data-gathering shows that the number of sunspots waxes and wanes in a cyclical or repetitive fashion. A typical solar cycle lasts 11.0 years with something like 3 to 4 years to reach "solar maximum," the time with the greatest number of sunspots on the solar disk, from the previous solar minimum.

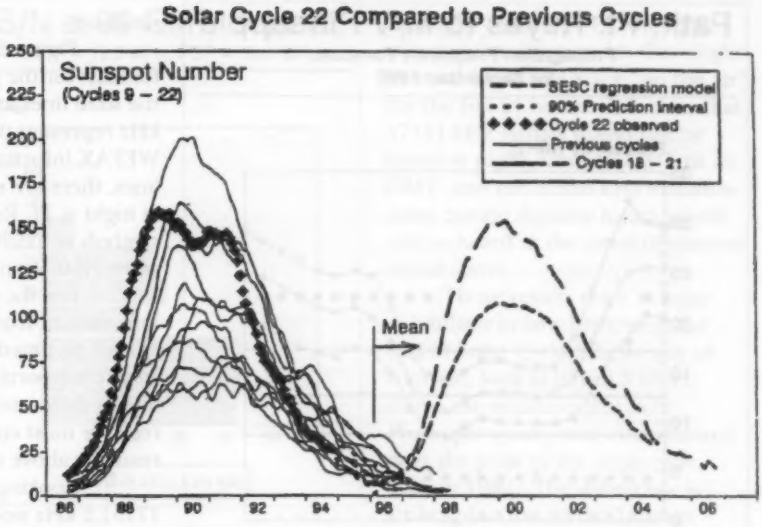

Figure 1. The variation of a smoothed sunspot numbers during a number of solar events and a predication for the coming cycle.

The data from a number of solar cycles (figure 1), indicates the variability of sunspot development, from cycle to cycle. At the present time, we're near the end of Solar Cycle 22, the current SSN down around 20 as compared to a SSN of about 160 at the last solar maximum back in July 1989.

That decline in solar activity or ultra-violet radiation incident on the upper atmosphere translates into a decline of the highest radio frequencies which can be transmitted along a path, say from a WEFAX station to a ship at sea. That idea was established in the mid-30's and used to aid radio communications during WWII. Since then, a tremendous amount of effort has gone into preparing global maps of the ionization in the upper atmosphere, the ionosphere, and methods were developed to predict how point-to-point communication are affected by daily and seasonal variations of solar illumination and even changes in solar activity, i.e., the number of sunspots.

Over the years, the leading governments of the world developed computer programs to plan their communication systems in the face of regular, anticipated changes in the sunspot cycle. The progress has been so rapid that large main-frame propagation programs of the 70's have been brought down to the PC level by the late 80's, the American IONCAP program being an example of a PC system to plan, forecast and aid in carrying out high frequency communications.

A PRACTICAL EXAMPLE

Let's consider a fictitious vessel, m/v ***Pineapple***, en route to the USA in mid September of 1995 and located at 22°N, 150°W. The weather conditions to the east of that position could be obtained by copying WEFAX transmissions from NMC at Pt. Reyes, California. A quick look at the broadcast schedule of NMC shows that it transmits on five (5) frequencies:

4346 kHz	NIGHT
8682 kHz	CONTINUOUS
12730 kHz	CONTINUOUS
17151.2 kHz	CONTINUOUS
22528.9 kHz	DAY

The distance between m/v ***Pineapple*** and NMC is only 1710 nautical miles. The question then becomes which frequency would be the best in getting the WEFAX data. Making use of the IONCAP program and after entering transmitter and receiver coordinates and the month and sunspot number, the program quickly forecasts the various frequency ranges, for each hour of the day, that would be appropriate to consider in copying transmissions from NMC to obtain a WEFAX chart.

For the month of September of 1995 (figure 2) the forecast from the IONCAP program gives not only a range of frequencies but also the probability they could be used in receiving signals from Pt. Reyes.

The highest curve, marked HPF for "highest possible frequency," shows the highest frequencies which could be used in a month, say on 10% of the days. The next curve, marked MUF for "maximum useable frequency," gives the frequencies during the course of a day when the probability of hearing Pt. Reyes is 50%. And the lowest curve, marked FOT for

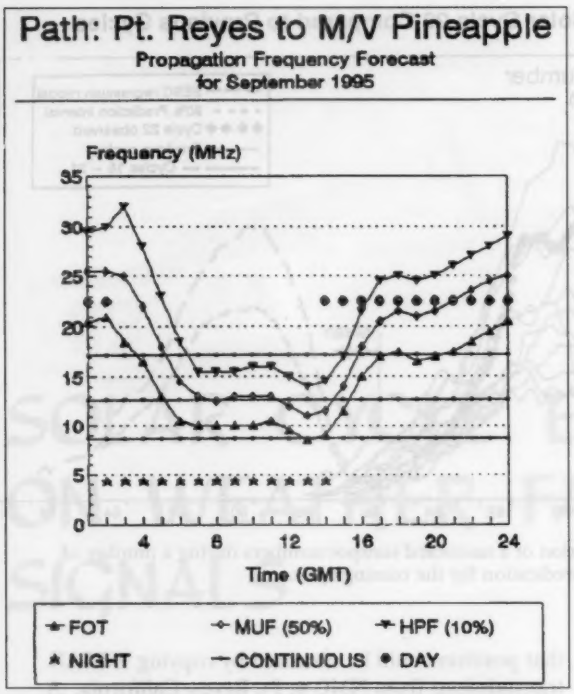

Figure 2. Propagation frequency for a path from Pt. Reyes, California to 22°N, 150°W in September 1995 (solar minimum).

"optimum working frequency" (in French), gives the frequencies during the course of a day when the probability of hearing Pt. Reyes is about 90%.

According to those definitions, listening for signals on frequencies below the MUF should meet with success more than 50% of the time and less than 50% of the time above the MUF. The procedure is to look at the operating schedule of NMC and and compare it with the frequency forecast to find the frequencies which promise success in getting the WEFAX data.

It should be stressed that the forecasting of successful radio communications is chancy. Propagation forecasting relies on the use of an extensive ionospheric database, surveys of ionospheric conditions in recent years gathered from around the globe. The controlling factor in radio communications—the sun—has gone through cyclical behavior for centuries and the target of its radiation—the earth—carries out its orbital motions around the sun in a regular manner. In some ways, ionospheric forecasting is just "more of the same" but on a longer, almost rhythmic time-scale.

There are ionospheric storms of a sporadic nature, but for about 90% of the time, the ionosphere does what is expected of it or, more appropriately, what's in its database. But, that's a way of saying that it's almost always within statistical ranges in the database.

Figure 2 contains not only the propagation forecast for the path in the month of September but the solid lines at 8682 kHz, 12730 kHz and 17151.2 kHz represent the frequencies on which NMC gives out WEFAX information continuously. In contrast to those lines, there are star symbols at 4346 kHz showing times at night at Pt. Reyes when NMC transmits and circular symbols at 22528.9 kHz showing times during the day when NMC transmits WEFAX.

For the m/v ***Pineapple*** to receive WEFAX information from Pt. Reyes, its WEFAX receiver must at least be tuned to a frequency on which the ionosphere supports propagation from Pt. Reyes, i.e., below one of the curves in figure 2. Beyond that, the WEFAX receiver must copy a signal that is loud enough to be readable above any noise background.

Looking at all the curves in the forecast, 17151.2 kHz would be a reasonable frequency to use for 22 to 02 UTC as that frequency is even below the FOT (90%) curve for that period; and using 12730 kHz looks reasonable for the interval 16 to 04 GMT also.

One can look over the forecast curves and the various WEFAX frequencies to see other possibilities.

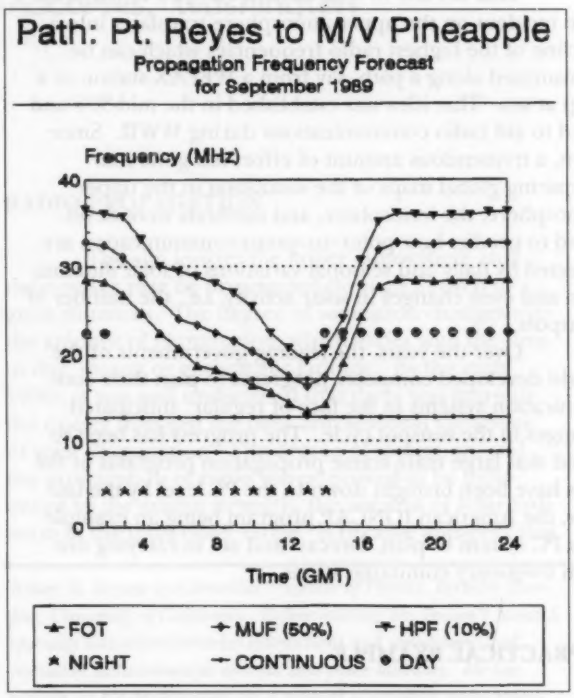

Figure 3. Propagation frequency forecast for a path from Pt. Reyes, California to 22°N, 150°W in September 1989 (solar maximum).

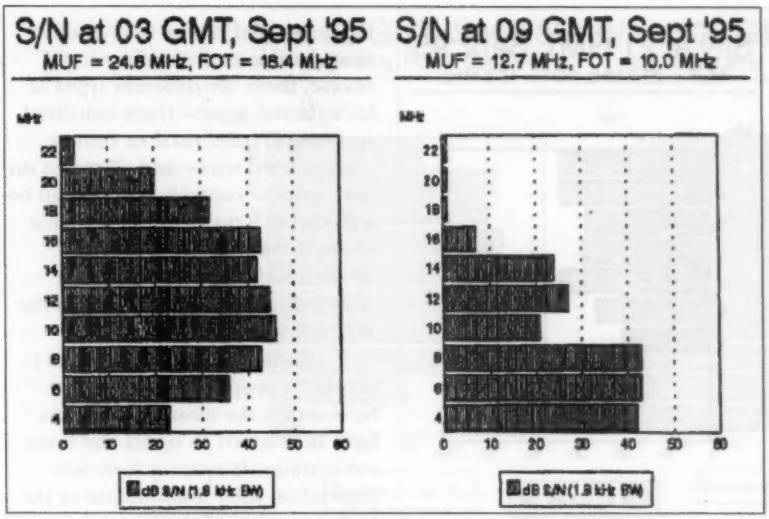

Figure 4. In this illustration, the signal–to–noise forecast for the path at 03 GMT and 09 GMT in September 1995.

But the rise and fall of those curves relate to changes in solar illumination, from day to night, and also to signal strength variations. In particular, signal absorption is the least at high frequencies and at night on a path (shown by the "stars") and the greatest on low frequencies and during daytime hours (shown by the "sun"). And the rise in propagation frequencies follows sunrise on the path, around 14 GMT, and begin to fall with sunset, around 02 GMT. Those last ideas are general in nature and go with the seasons while those particular times relate just to the month of September.

The m/v ***Pineapple*** is located at 22°N, 150°W and heading for the West Coast; looking at the "Contents of Transmissions" for NMC at Pt. Reyes, it is clear that Map Area 2 (20°N to 70°N, 115°W to 175°W) is the one of interest and for an analysis of surface conditions, the forecast of ionospheric propagation must be considered for the times of their transmission, 0310/1510 GMT and 0919/2119 GMT, or retransmission, 0345/1545 GMT and 0955/2154 GMT.

For successful WEFAX reception, one can be reasonably confident by making conservative choices, picking two frequencies below the MUF (50%) curve:

Time (GMT)	Frequency #1	Frequency #2
0310	17151.2 kHz	12730 kHz
0919	8682 kHz	4346 kHz
1510	12730 kHz	8682 kHz
2119	17151.2 kHz	12730 kHz

Except for the 4346 kHz transmissions during the night at 0919 GMT, the three transmission frequencies that might be used for WEFAX are "on the air" for the full 24 hours. It is clear that 17151 kHz signals would not be heard at night, from 07 GMT to 15 GMT, and the 22528 kHz transmissions during daytime hours would not be heard at the times of interest noted above.

Those results refer to solar conditions in late 1995, near the end of Solar Cycle 22. By way of contrast, look at figure 3 which shows the situation that m/v ***Pineapple*** would have encountered near the peak of the solar cycle, back in 1989. The difference is striking but the method shown above still gives two choices of WEFAX frequencies, only at higher frequencies:

Time (GMT)	Frequency #1	Frequency #2
0310	17151 kHz	12730 kHz
0919	17151 kHz	12730 kHz
1510	17151 kHz	12730 kHz
2119	22528 kHz	17151 kHz

Of the two frequencies, the one to use depends on the signal strength from NMC and the noise picked up by the ship's receiver, which involves a comparison of signal–to–noise ratios on the two frequencies for each of the hours.

SIGNALS AND NOISE

The strength of the WEFAX signal depends on transmitter power and the distance to the receiver. The signals must be propagated by the ionosphere, being bent down by the ionization which results from solar illumination. In radio parlance, the signal "hops" between Pt. Reyes and m/v ***Pineapple***, rising to a peak altitude of about 300 kilometers altitude and then going downward again toward earth. For a distance of 1710 nautical miles , NMC's signal may reach the m/v ***Pineapple*** in one hop at an elevation angle of 6 degrees.

Ionization at such altitudes bends the radio signals or rays downward but there may be ionization at lower altitudes as well, say around the 60 to 90 kilometer level, which tends to absorb or reduce the signal strength because the atmosphere is so dense there. Such ionization will be present at those altitudes on

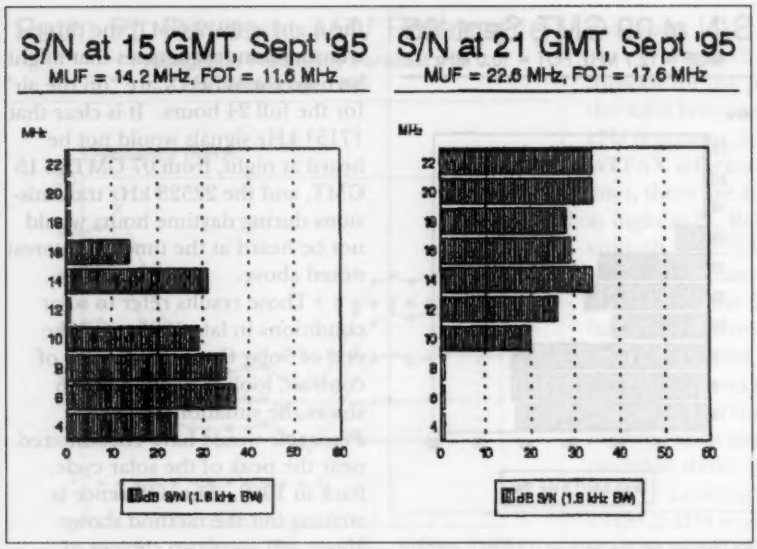

Figure 5. Illustrates signal-to-signal noise forecast for the path at 15 GMT and 21 GMT in September 1995.

portions of the path which are illuminated by the sun. This absorbing ionization is absent at night and signals are correspondingly stronger.

Noise heard on radio receivers comes mainly from two sources, thunderstorms and electrical devices nearby. The atmospheric noise covers a wide range of frequencies and actually propagates just like any other radio signal. Man-made noise is more local in origin and largely produced during waking hours. Electrical machinery and devices are in constant use on shipboard, and the noise environment may be somewhat different than that ashore.

The IONCAP program used to find the times when signals are propagated, also calculates signal strengths and then compares them with man-made noise. With the understanding that IONCAP uses noise data from measurements taken ashore, one can use the program to calculate signal-to-noise ratios and use them to choose further between the two frequencies for WEFAX reception cited above.

But it should be noted that signal-to-noise ratios are comparisons of the signal intensity and noise intensity, i.e., comparisons of the two powers received at the same time. As such they are expressed in decibels (dB), values on a logarithmic scale, similar to values for loud, noisy machinery in confined spaces.

In the radio case, a S/N ratio of 60 dB means the signal is quite loud, a million times stronger in intensity than the background noise, and could be quite unpleasant, even painful, if listened to for any lengthy period of time. For a S/N ratio of 30 dB, however, the signal is only a thousand times stronger than the noise, and can be tolerated for considerable periods of time. Of course, there are different types of background noise– from industrial, residential, quiet rural or remote unpopulated sites– and all radios do have volume controls, so they can be adjusted to a proper level of signal strength for listening or for the operation of any electronic gear attached to the receiver, such as the WEFAX system.

Earlier, IONCAP was used to provide a propagation frequency forecast for the month of September. In contrast to signal and noise calculations, frequency forecasts depend on solar illumination of the higher reaches of the ionosphere and are independent of transmitter power, antennas and such. Signal and noise factors, on the other hand, are derived from conditions at lower altitudes and even factors at ground level, like transmitter power and antennas.

SIGNAL/NOISE FORECASTS

The IONCAP propagation program can determine what S/N ratios would be like across the spectrum. But IONCAP is not discriminating in its output in that it provides S/N values so long as the frequency in question is below the HPF at the time in the propagation forecast. In other words, IONCAP's S/N forecast may be correct but as a practical matter, the User will want to disregard those frequencies which are above the operational threshold, say the MUF (50%) for WEFAX, as well as frequencies and times for which no WEFAX information is transmitted.

Figures 4 and 5, give forecasts of S/N ratios on 10 different channels from 4 MHz to 22 MHz which cover the frequency range and hours of WEFAX transmissions from NMC. Figure 4 corresponds to evening and night (03 and 09 GMT) while Figure 5 deals with the morning and day (15 and 21 GMT) on the West Coast. In those calculations, the transmitter power has been taken as 10 kW, dipole antennas at both transmitting and receiving stations, and noise to be that in a quiet environment.

The earlier choices of WEFAX transmissions for evening (17151 kHz and 12730 kHz) and night-time (8682 kHz and 4346 kHz) are supported and confirmed by the S/N forecasts. That is not the case, however, for the original morning (12730 kHz

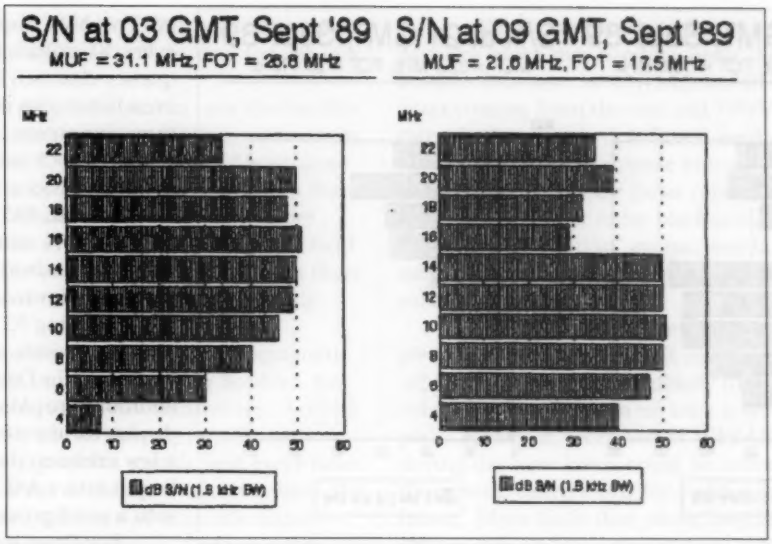

Figure 6. Illustration above depicts signal–to–signal forecast for the path at 03 GMT and 09 GMT in September 1989.

and 8682 kHz) and day-time (12730 kHz and 8682 kHz) choices. Thus, the S/N forecast shows low S/N ratios for 12730 kHz at 15 GMT and 8682 kHz at 21 GMT.

The low S/N ratio at 15 GMT is due to the fact that the propagation mode is changing, from two hops at night to one hop in the day, and thus is unreliable during transition. The low S/N ratio at 21 GMT is simply a matter of signal absorption, mentioned earlier, as the path is in full day-time illumination, with signal absorption at both ends.

Having examined the S/N forecasts for the present time, near solar minimum, it is of interest to do the same for September 1989, near the last solar maximum. Figures 6 and 7 show S/N ratios for the same frequency channels and times used earlier. At the higher level of solar activity, both the MUF and FOT values were more than 8 MHz higher in 1989 than now in 1995. Those increases in ionization result in greater access to the higher channel frequencies, particularly in evening and nighttime hours. During the day (21 GMT), the greater ionizing radiation from the sun results in more signal absorption at low altitudes for the same noise levels, reducing access to channels at the lower frequencies.

Considering the S/N forecast, the choices for WEFAX transmission frequencies differ from those earlier based on just the propagation frequency forecast because of the greater number of channels available. But using the greatest S/N ratio as a criterion for selecting a WEFAX frequency, the following choices result.

Time (GMT)	Frequency #1	Frequency #2
0310	17151 kHz	12730 kHz
0919	12730 kHz	8682 kHz
1510	12730 kHz	8682 kHz
2119	22528 kHz	17151 kHz

COMPARISON OF RESULTS

Looking at the frequency selections for solar minimum and solar maximum, it's clear that the optimum WEFAX frequencies for solar minimum are lower than those at solar maximum, particularly at night (09 GMT) and during the day (21 GMT). The need for a lower frequency at night at solar minimum is due to the greater decay of ionization at the 300 km level; in essence, at solar minimum there is less ionization available for night-time propagation when the sun begins to set on the path. The choice of a lower frequency during the day at solar minimum is more for reliability purposes, the WEFAX frequency being quite close to the MUF (50%) value.

A comparison of the overall features of figures 4 and 5 with figures 6 and 7 shows reduced accessibility to the higher channels during times of low solar activity or sunspot counts. That sort of decline is a general result and applies to all aspects and applications of HF radio communication. Figure 1 shows that the loss in channel accessibility occurs over about a 6–year period once solar maximum has been reached.

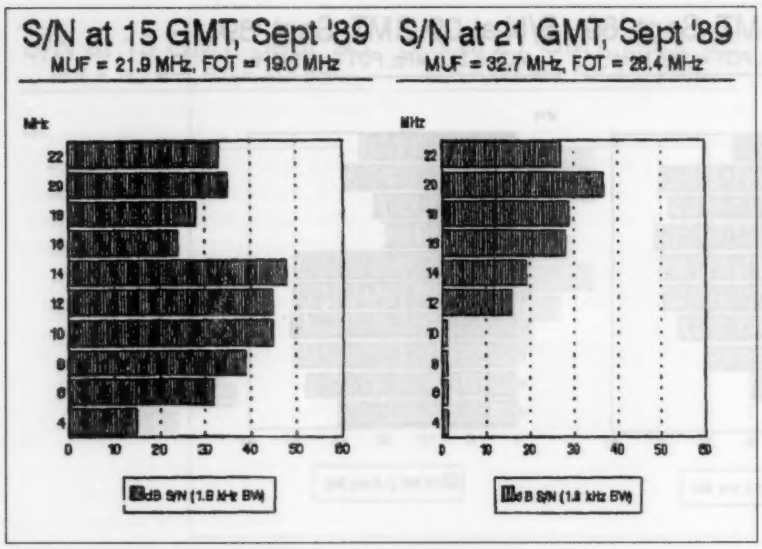

Figure 7. Illustration above shows the signal–to–noise forecast for the path at 15 GMT and 21 GMT in September 1989.

Since the number of WEFAX channels is quite limited for a given station, adjustments in reception times may be a problem, shifting down from a frequency which has given good service during times around solar maximum to other frequencies as solar minimum is approached.

That's a problem for mariners, but there may be help in coping with it; beyond that, the good news is that solar minimum for Cycle 22 may be reached in 1996 and then the higher channels will start to become available again. Figure 1 can be used for the current estimates of what solar activity will be like in the near future.

Now we come to the matter of "help." A new HF propagation program, PropMan (HF PROPagation Resource MANager),was introduced recently by the Collins Avionics and Communications Division of the Rockwell International Corporation. The PropMan program was developed to support use of ALE (Automatic Link Establishment) by government agencies such as NOAA, NASA and NSF and seems well suited for WEFAX matters. PropMan uses the IONCAP methodology to calculate S/N ratios for frequency channels from 2 to 40 MHz as well as MUFs, both in real-time and for the next 24 hours, and the results of those calculations are then displayed graphically on the computer screen.

The PropMan software requires an IBM compatible computer (386 CPU with a 387 math coprocessor recommended), color EGA or VGA monitor, a graphics card, and 2 MB of RAM and 490K memory. DOS 3.2 or higher is required. Once a path is selected, PropMan displays S/N ratios every 30-seconds for all the frequency channels from 2 to 40 MHz, even faster with 486-based or Pentium computers.

The S/N ratio for a frequency is displayed according to whether it is >65 dB-Hz, >35 dB-Hz and <35 dB-Hz. (S/N values displayed are for 1 Hz bandwidth and should be corrected downward for WEFAX by subtracting 33 dB for 1.8 kHz USB bandwidth, as has already been done in Figures 4 to 7. In addition, PropMan generates a S/N display for the next 24 hours and in a few minutes, the results can also be put into a ASCII file for printing with a word-processor.

For those interested in PropMan, more information may be obtained by calling (319) 395-5100 or writing:

Collins Avionics and Communication Division
350 Collins Road NE,
Cedar Rapids, IA 52498-0120.

PROPAGATION DISTURBANCES

In essence, this approach deals just with the effects of solar radiation in the ultra-violet part of the spectrum. But the sun also emits particles from its outer atmosphere, the corona. That form of radiation, low-energy electrons and protons, make up the solar wind and approach the earth either in a steady stream or, on occasions, in gusts and blasts. The latter circumstances disturb radio propagation through the interaction between the solar wind and the earth's magnetic field.

The geomagnetic field's importance to radio communication comes from the fact that the ionization in our atmosphere, when released by ultra–violet radiation, is constrained to motions about the magnetic field lines. In the slowly–varying circumstances during a solar cycle, the effect of the geomagnetic field is seen only through the fact that ionospheric maps are better organized using geomagnetic coordinates than geographic coordinates.

But when gusts of the solar wind hit the outer reaches of the earth's field, an interaction occurs in which the magnetic control of the ionosphere is disturbed and propagation suffers. Depending on the degree of the disturbance, the FOT and MUF values for communication paths going to high latitudes may

drop by 10% or more. Thus, WEFAX communications at high latitudes may suffer as well, forcing the use of a lower frequency.

NOAA has compiled statistics over the last five solar cycles which show that about 200 storms occur in a typical solar cycle of 11 years duration. About three times as many storms occur after solar maximum than before, and storms, whatever the year, occur more often at the equinoxes when the earth's magnetic field faces squarely into the oncoming solar wind. But there is no daily variation to the onset times of magnetic storms.

NOAA monitors the state of the geomagnetic field at a number of locations, including Boulder, Colorado which is close to the WWV transmitter. Accordingly, WWV (and WWVH in Hawaii) broadcasts information on the state of the earth's field every hour. That information comes in the form of two indices, the K-index which gives a measure of magnetic disturbance during three hour intervals of GMT and the A-index which is
a 24-hour measure of disturbance.

Those magnetic indices are broadcast at 18 minutes after each hour on WWV and 45-minutes after each hour on WWVH. Starting at 2118 GMT, WWV gives a 21-hour estimate of the A-index of the current day and when 24 GMT is reached, that estimate is replaced by the actual A-index for the day. But K-indices are broadcast every hour and apply to the most recent GMT interval, e.g., 00 to 03 GMT, 03 to 06 GMT, etc. In addition to giving the magnetic indices, the WWV broadcasts provide plain-language a forecasts of solar and magnetic activity for the coming day.

Magnetic storm conditions are said to exist when the A-index is 40 or higher. The K-index ranges from 0 to 9, corresponding to quiet magnetic conditions on one hand and severe magnetic storm conditions on the other. As a practical matter, radio propagation will be adversely affected when the K-index reaches 4 and goes beyond that value. That being the case, listening to a WWV broadcast prior to a WEFAX schedule would help in choosing the right frequency.

While magnetic disturbances are seen all around the earth at a given time, there are other more localized disturbances of radio propagation. For example, bursts of solar X-rays may be sent out at the time of a solar flare. Those X-rays produce ionization at low altitudes where signals are absorbed and if the emission of X-rays is intense enough, radio communications may be "blacked out" over the sunlit side of the earth. Such radio black-outs are of short duration, however, ranging from a few minutes to an hour. And such events occur more often around solar maximum than other times in a solar cycle.

Finally, some solar flares send out high-energy particles which may produce polar radio black-outs. Particle detectors on a NOAA satellite detect such radiation coming from the sun and WWV broadcasts indicate whether the particle flux is weak, only observed at satellite altitudes, or intense enough to disturb radio propagation across the polar caps. Unlike the solar X-ray events, polar radio black-outs, called PCAs for "polar cap absorption" events, may last for days at a time. But again, they are mainly found around times of solar maximum.

Going back to the example of the m/v ***Pineapple*** and its need for WEFAX information on conditions off the West Coast, it is unlikely that a PCA event would ever affect propagation on such a low latitude radio path. However, reception of WEFAX transmissions during day-time hours could be interrupted by a X-ray flare event, called a SID for sudden ionospheric disturbance. More likely than those two disturbances are the effects of magnetic activity where WEFAX reception could be affected at any time of the day or night if the K-index goes beyond 4.

CONCLUSION

Like all types of HF radio communication, WEFAX transmissions are affected by the state of the ionosphere, how it varies during a solar cycle and with sporadic disturbances. The slow changes in radio propagation during a solar cycle can be dealt with by methods which are currently available, computer software which gives predictions of propagation frequencies as well as forecasts of signal-to-noise ratios on any path. In that regard, the new PropMan program looks quite promising for evaluating choices of WEFAX frequencies.

Ionospheric disturbances pose a problem for the reception of WEFAX transmissions but the information in WWV broadcasts would help in anticipating the need to lower WEFAX reception frequencies because of solar and magnetic activity. For the next year or so, lower WEFAX frequencies will remain in use during the conditions of solar minimum. But with the rise in solar activity again, probably peaking in Year 2000, higher WEFAX frequencies will return to use again. The problem for the mariner is to anticipate when the changes will come.

North Atlantic Hurricane Season -1994

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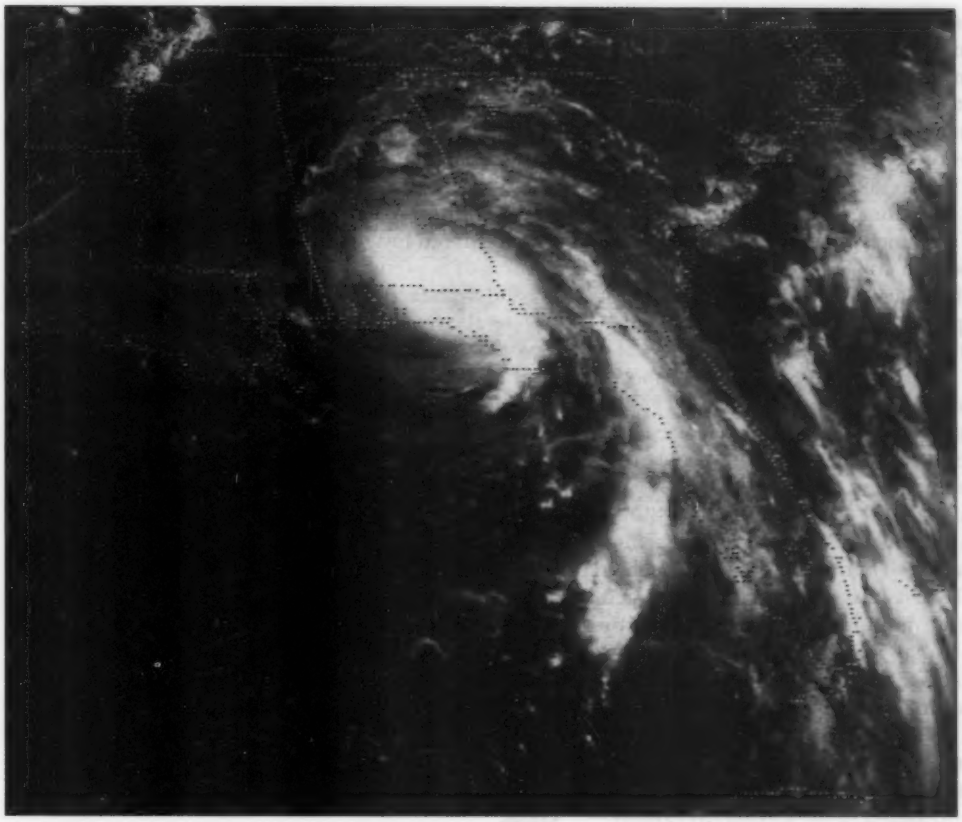
The 1994 Atlantic hurricane season evolved in an unusual way. During the normally stormy period of late August through October, there were no hurricanes. Then, in November two hurricanes formed for only the second time on record. Those hurricanes were the strongest (Florence) and deadliest (Gordon) tropical cyclones of the season.

For the year, a total of seven tropical storms, three of which became hurricanes, made 1994 the fourth consecutive year that totals fell short of the 50-year averages of ten and six, respectively, for those systems. It was also the fifth year in a row without a hurricane in the Caribbean Sea. There were no major hurricanes (one-minute winds of at least 96 knots) in 1994.

The National Hurricane Center (NHC) received many valuable ship reports during the hurricane season. Most came from vessels near Gordon's odd track. The strongest wind speed reported at sea this year was 68 knots, observed during Gordon by the ***Advantage*** and the ***Tropic Sun***.

Tropical Storm Alberto

The year's first tropical storm, Alberto, formed near the end of June when a tropical wave moved into an area of relatively light vertical wind shear over the northwestern Caribbean Sea. Weather satellite pictures and rawindsonde data indicated that the associated thunderstorm activity increased around a low-level circulation center near the western tip of Cuba on June 30. This activity became organized into a tropical depression that day and produced heavy rainfall over western Cuba, including 10 inches at the Isle of Youth. The depression initially moved westward at 7 knots, but over the following 2 days turned northward. The winds associated with an upper-level low and trough over the Gulf of Mexico brought about this change and created a moderate southerly wind shear that kept the low-level cloud center partially exposed on satellite pictures. When the upper-level system retreated westward early on July 2, the circulation center became more embedded in the thunderstorm activity. Data from a U.S. Air Force Hurricane



The visible image from GOES-7 on the 3rd of July at 1700 UTC, shows Tropical Storm Alberto just after it center made landfall on the Florida Panhandle.

Hunter reconnaissance aircraft suggested that the depression then strengthened into a tropical storm. This was confirmed by surface reports near the storm's center where the ship ***Sanko Quest*** encountered sustained winds of 35 to 40 knots with gusts to 50 knots. During the afternoon, the ***Robert E. Lee*** reported a wind speed of 44 knots. Alberto was moving toward the north at 12 knots when its center made landfall on the Florida panhandle near Destin on the morning of July 3. The storm was then at its peak intensity, with winds of 55 knots, a central pressure of 993 mb, and evidence on satellite pictures of a recessed spot near the middle of the central cloud feature that possibly represented the first stages in the development of an eye. Although there were no casualties and only minor damages associated with the landfall, 13 people were rescued from boats over the northeast Gulf of Mexico.

Surface wind speeds decreased rapidly after Alberto made landfall. Unfortunately, the system nearly stalled after its center moved a couple hundred miles inland. For several days, heavy rain fell over portions of western Georgia, eastern Alabama and the Florida panhandle. Americus, Georgia received more than 533 millimeters of rain in a 24-hour period and 701 millimeters over the period of July 4 to 7. The Flint River at Albany, Georgia crested about 7 meters above flood stage. Many dams failed. The floods were directly responsible for the loss of 28 lives in Georgia and 2 in Alabama, and damages have been estimated at about $500 million. A total of 55 counties in Georgia, 13 in Florida and 10 in Alabama were declared disaster areas.

Tropical Storm Beryl

Ship reports helped identify a weak 1014-millibar surface low off the northwest coast of Cuba during the evening of August 12. This low moved generally toward the north northwest and, based on data from aircraft reconnaissance and satellite imagery, became a tropical depression on the morning of the 14th while centered about 100 miles to the south of Pensacola, Florida. By early on the 15th, Doppler radar data from Eglin AFB indicated that the system was better organized and had begun to spread rain over portions of the west coast of the Florida

peninsula and over the Florida Panhandle.

The cyclone began moving toward the north northeast when a mid-tropospheric trough approached from the west on the 15th. It strengthened and made landfall, as Tropical Storm Beryl, with sustained wind speeds near 50 knots and a central pressure of about 1000 millibar that evening. Doppler radar showed that the strongest winds accompanied Beryl's rainbands. The highest sustained wind speed reported on land was 46 knots at Tallahassee. The winds over Apalachee Bay were likely stronger. A gust to 57 knots was reported from the St. George Island Causeway. Gusts to 56 knots occurred at Tallahassee and Turkey Point. A storm surge of .88 meters above normal astronomical tide was reported from Apalachicola. Somewhat higher values likely occurred between Apalachicola and Cedar Key, an area where coastal flooding was reported.

After landfall, Beryl accelerated toward the north northeast as a tropical depression before being absorbed by a frontal system over coastal New England early on August 19. In its dissipating stages, Beryl generated very heavy rain and tornadoes from Georgia to New York. Rainfall totals larger than 254 mm occurred in Florida, Georgia, South Carolina and North Carolina, causing several rivers to flood. At least 23 tornadoes occurred in South Carolina. One of those, in Lexington County, injured 37 people. Damages from Beryl were estimated at $73 million, with about half of that attributed to the Lexington County tornado.

Hurricane Chris

Hurricane Chris originated from a cluster of thunderstorms associated with a tropical wave. Signs of cloud rotation appeared on August 15 when the wave was located about midway between Africa and the Lesser Antilles. The system became a tropical depression the following day, but by the 17th, it intensified to hurricane status. The center of Chris passed 50-100 miles from a ship (of unknown name) which reported winds of 58 knots at 1500 UTC and 52 knots three hours later.

The maximum wind speed in Chris was 70 knots and this intensity was maintained throughout most of the 19th. Thereafter, strong wind shear disrupted the circular symmetry of the cloud pattern and caused weakening. Chris had only 35-knot winds when it passed about 75 miles to the east of Bermuda and that site reported sustained winds no higher than 15 knots. The storm accelerated toward the northeast on August 22 and regained some strength. The ***Adabelle Lykes*** encountered 40-knot winds to the east of Chris on that day. On the 24th, Chris merged with a frontal system and lost its identity southeast of Newfoundland.

Tropical Storm Debby

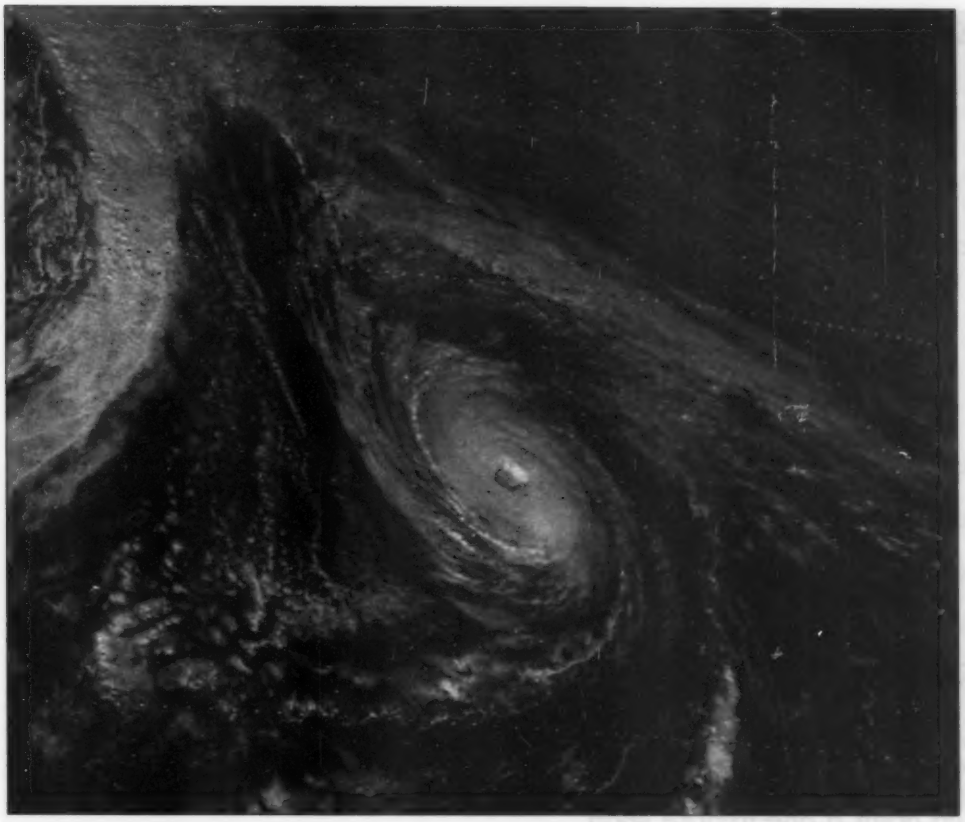
Tropical Storm Debby formed from a tropical wave centered just east of the Lesser Antilles on the evening of September 8. A concentrated area of showers and thunderstorms developed and the system's low-level circulation became better defined by the next day. Surface observations and satellite pictures early on the 9th suggest that the system became a tropical depression about 125 miles to the east of Barbados.

The cyclone moved toward the westnorthwest at 17 knots, into a mostly westerly wind shear that prevented the cloud pattern from becoming very organized. Nevertheless, the depression became a tropical storm on the evening of the 9th. A NOAA reconnaissance flight detected 50 to 60 knot winds at a flight level of 457 meters in the vicinity of thunderstorms over the northeast part of the system. A few hours later, this activity spread across the middle part of the Lesser Antilles islands. Two sites on Martinique reported 10-minute averaged winds near 55 knots with gusts to about 85 knots. The nearby ship **PJRB** (name unknown) reported a sustained wind of 44 knots.

Debby's winds damaged the banana crops of Martinique and St. Lucia and some electrical service was lost there. More serious damage was caused on those islands by heavy rains, with totals as large as 183 mm reported. Four people were killed in two landslides on St. Lucia and a drowning was reported in Martinique. The landslides blocked roads and covered the runways at St. Lucia's main airport to a depth of 50 mm. Flood waters washed away bridges, hillside shacks, and was chest-high in the village of Anse La Raye.

Strong wind shear weakened Debby when the storm moved across the eastern Caribbean Sea. By early on the 11th, a closed circulation center could not be identified by the crew aboard the reconnaissance aircraft, indicating that the system had degenerated back to a tropical wave. Even so, Debby, and its remnants, caused some rivers to flood in the Dominican Republic and three deaths (apparently related to downed power lines) occurred in that country. The rough weather was also responsible for the drowning of a fisherman off the southwest coast of Puerto Rico.

Remnants of the system were tracked on satellite pictures to the vicinity of the southeastern Gulf of Mexico on August 15.



Hurricane Florence, near its peak intensity, as seen in a GOES-8 visible image at 1715 UTC on the 7th of November.

Tropical Storm Ernesto

Ernesto was a short-lived tropical storm that produced no significant effects over land or for mariners. Its origin was a tropical wave, and its development into a tropical depression over the far eastern Atlantic on September 21 marked one of the latest dates for a depression to form in that area since such records began in 1886.

A mid-level trough dominated the area of formation and the associated steering flow directed the newly-formed cyclone generally northward into an area of strong vertical wind shear. Although the cyclone initially intensified to become Tropical Storm Ernesto, the shear soon became overwhelming and the storm then weakened. By the 24th, the cloud pattern consisted of only a few thunderstorms near a swirl of low clouds. A remnant disturbance moved westward to westsouthwestward for another few days and was last identified about 775 miles to the east of the Leeward Islands on September 29.

Hurricane Florence

Following Ernesto, the Atlantic hurricane basin was rather inactive for about 6 weeks. In fact, there were no tropical storms or hurricanes in the month of October. November, on the other hand, made up for lost time with two hurricanes.

On November 2, Hurricane Florence formed about 1000 miles to the eastsoutheast of Bermuda from the interaction of a stationary frontal band and a low aloft. The incipient disturbance consisted of a band of strong thunderstorms and windy conditions located about 200 miles to the northeast of the developing low-level circulation center. This cloud and wind pattern meant that Florence originated as a subtropical cyclone. The nearby ***Sedco BP-471*** several times reported winds of about 35 knots during this stage.

By late on the 3rd, the thunderstorm activity became concentrated close to the circulation center, and Florence made a transition to a tropical cyclone. Slow strengthening followed and a partially formed

1994 Atlantic Hurricane Season Statistics

No.	Name	Class[a]	Dates[b]	maximum sustained wind Knots)[c]	lowest press (mb)	U.S. damage ($ millions)	deaths
1	Alberto	T	6/30-7/7	55	993	500	30
2	Beryl	T	8/14-8/19	50	999	73	0
3	Chris	H	8/16-8/23	70	979	0	0
4	Debby	T	9/9-9/11	60	1006	0	0
5	Ernesto	T	9/21-9/26	50	997	0	0
6	Florence	H	11/2-11/8	95	972	0	0
7	Gordon	H	11/8-11/21	75	980	400	1145

a ST: subtropical storm, wind speed 34-63 kt.
T: tropical storm, wind speed 34-63 kt.
H: hurricane, wind speed 64 kt or higher. Dates begin at 0000 UTC and include tropical depression stage
b Dates begin at 0000 UTC and include tropical depression stage
c Wind speed over a one-minute span

eye appeared on the afternoon of the 4th.

Florence moved first toward the northwest, but then nearly stopped at the most western point of its track, about 700 miles to the east of Bermuda on the 7th. The cyclone was then swept rapidly northeastward on November 7 to 8 by an approaching powerful mid-latitude storm. As it accelerated to about 45 knots, a distinct eye became apparent and it is estimated that Florence reached its peak intensity of 95 knots as it neared the North Atlantic shipping lanes. The ***Neptune Diamond*** reported 40-knot winds and a pressure of 988 millibars on the 8th.

Fortunately, mariners were able to avoid the strongest part of the hurricane and Florence rapidly lost its tropical characteristics and weakened when it became absorbed by the mid-latitude storm late on the 8th.

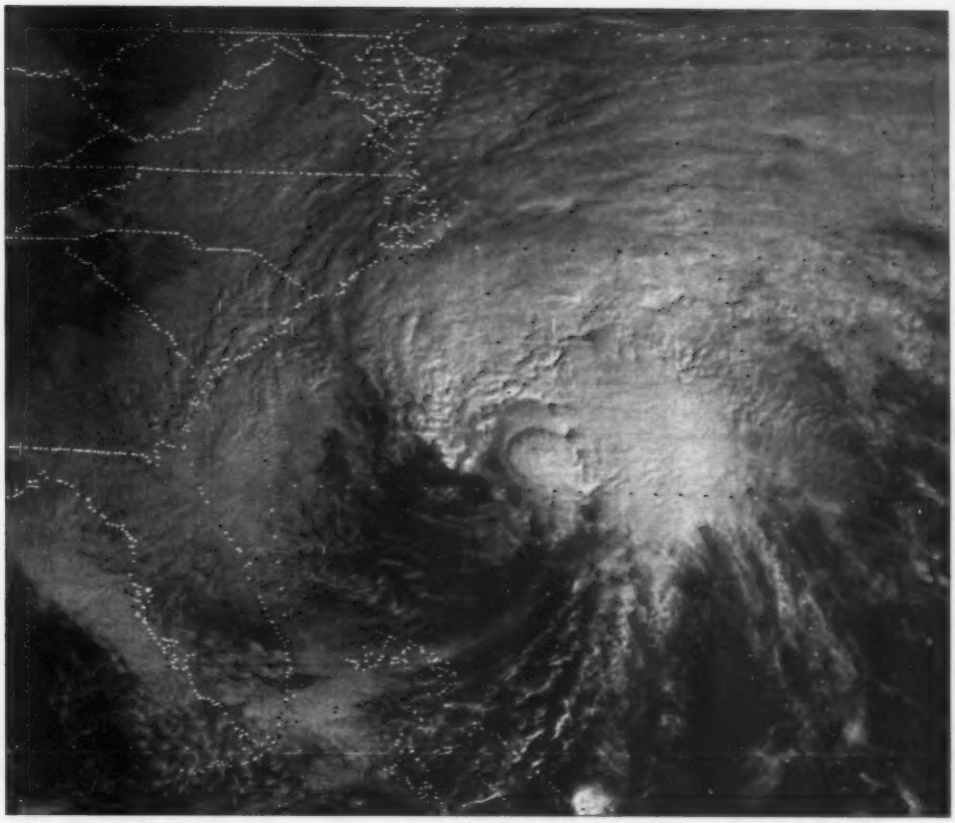
Hurricane Gordon

Hurricane Gordon originated over the southwestern Caribbean Sea from a low-level cyclonic circulation induced by two tropical waves. The system soon developed a complex structure resulting from interactions with upper-level disturbances and strong wind shear. Ultimately, it would also have one of the most convoluted tracks in years.

Strong thunderstorms developed in the circulation on November 8, the day that the system became a tropical depression. The associated heavy rains led to six fatalities in Costa Rica. Gordon first moved northward along the coast of Nicaragua, but then turned toward the northeast and became a tropical storm on the 10th. At this point, Gordon consisted of a small vortex within a broad cyclonic circulation.

Although the cloud pattern was sheared by an upper-level southwesterly flow on November 11 to 12, Gordon generated bursts of strong thunderstorms and gusty winds. In fact, a gust of 104 knots occurred in an exceptional strong thunderstorm at the U.S. Naval Base at Guantanamo Bay, Cuba, but this speed was not considered representative of Gordon's circulation.

The center of the storm crossed Jamaica and eastern Cuba on the 13th. Heavy rains to the east of the center caused catastrophic flooding and mud



Gordon was strengthening toward hurricane intensity and moving toward the northeast when this GOES-8 visible picture was taken at 1415 UTC on November 17.

slides that led to the loss of 1,122 lives in Haiti.

On November 14, the cloud pattern and wind field became even more poorly defined. Eventually, however, a dominant circulation center appeared just south of the central Bahamas and this center began moving toward the westnorthwest. Just before dawn on the 15th, radar observations placed the center of circulation a little south of the Florida Keys. Gordon turned toward the northeast and made landfall as a tropical storm over southwestern mainland Florida on the 16th. The storm crossed the Florida peninsula during the afternoon accompanied by sustained wind speeds near 45 knots and several tornadoes. Rainfall totals as high as 381 mm were reported. A total of eight people died in Florida, seven by drowning and one due to injuries sustained in a tornado. Considerable beach erosion was reported. Damage in Florida approached $400 million with most of the losses to agriculture.

Observations from the ***Hoegh Dyke*** indicated that Gordon began to strengthen when it left Florida and entered the southwestern Atlantic. On the 17th, Gordon became a hurricane and reached its peak intensity, 75 knots. The ***Finnsnes***, ***Advantage***, ***Tropic Sun***, and ***Star Georgia*** then each reported wind speeds of at least 60 knots. During this period, the ***Star Evviva*** provided the lowest surface pressure report for this storm and for the season, 987 millibars.

Gordon appeared to be on a course that would soon take it away from the U.S. mainland. Rather abruptly, however, the hurricane slowed when steering currents unexpectedly collapsed. Gordon then looped back toward the south, just offshore from North Carolina, where some beach erosion occurred. Fortunately, Gordon steadily weakened as it headed south and, by the time it had turned westward and reached the shoreline of northeast Florida late on the 20th, it was a tropical depression on its way toward dissipation.

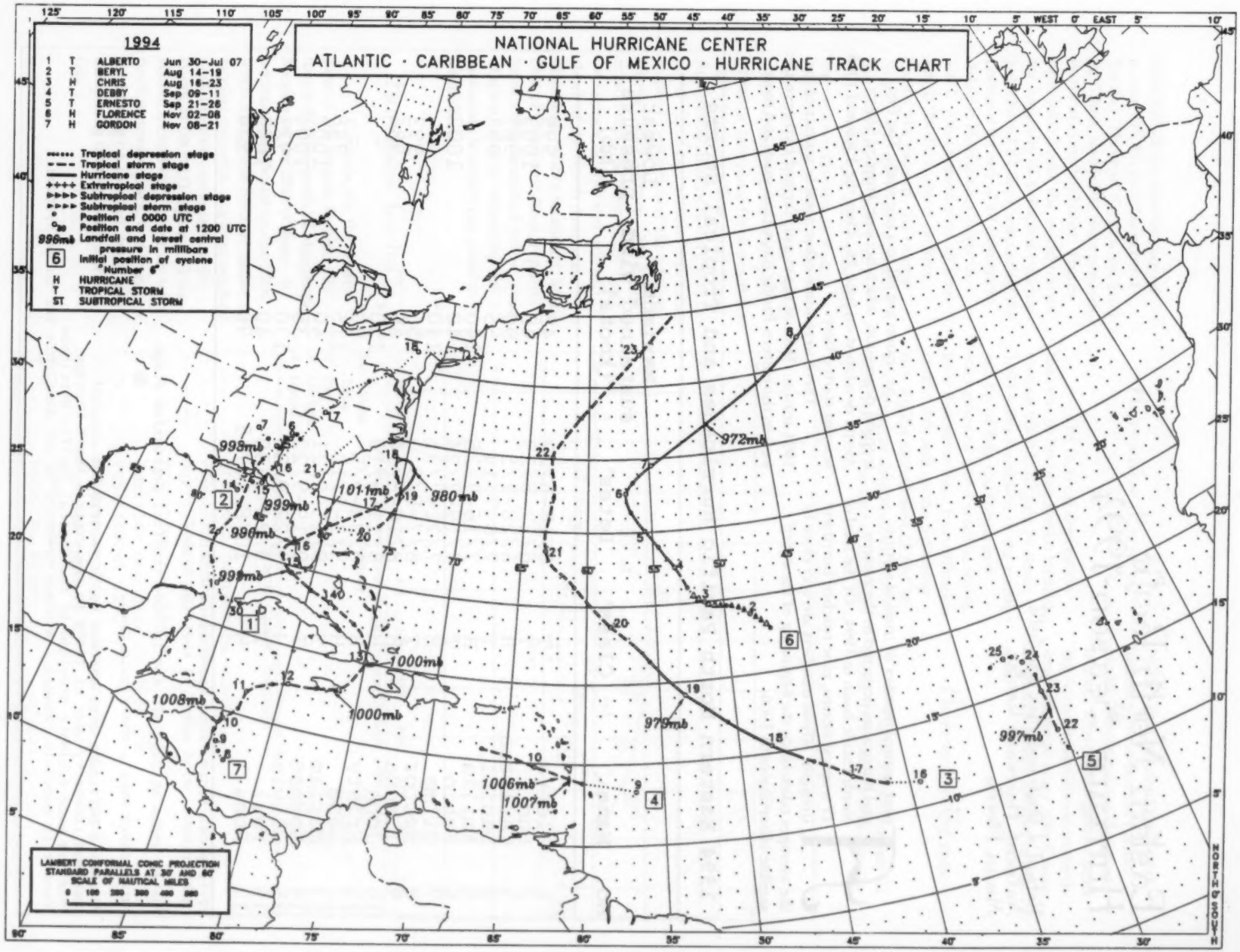
Acknowledgments

Edward Rappaport and Lixion Avila are Hurricane Specialists at NOAA's National Hurricane Center in Miami, Florida. Also contributing to this report were their fellow Specialists Miles Lawrence, Max Mayfield, and Richard Pasch.

Tropical Cyclone Winds
(ship encounters of at least 34 knots)

Tropical Cyclone	Ship/Platform name or ID	Date Mo/Da	Time UTC	Position LatN	Position LonW	Wind (kt) Dir/Speed*	Pressure (mb)
Alberto	Sanko Quest	7/02	1440	26.2	87.0	---/35-40	1002.-
	Robert E. Lee	7/02	1800	27.2	87.0	060/44	1003.3
	NKRV	7/02	1800	25.6	85.7	360/35	1015.1
Beryl	none						
Chris	unknown	8/17	1200	11.5	42.1	200/45	-----.-
	unknown	8/17	1500	11.2	42.5	210/58	1001.0
	unknown	8/17	1800	11.5	42.8	210/52	1010.0
	Star Eagle	8/22	1800	37.5	60.5	210/34	1014.0
	Adabelle Lykes	8/22	2100	37.1	58.2	190/40	1017.0
Debby	PJRB	9/10	0600	14.5	61.1	130/44	-----.-
	ELQN2	9/10	1500	16.3	59.7	090/37	-----.-
Ernesto	none						
Florence	Sedco-BP 471	11/02	0600	26.1	44.8	080/34	1014.5
	Sedco-BP 471	11/02	1200	26.1	44.8	110/34	1015.8
	Sedco-BP 471	11/03	0000	26.1	44.8	130/36	1015.8
	Neptune Diamond	11/08	1800	43.9	35.4	140/40	998.0
Gordon	Tropic Sun (3EZK9)	11/13	1200	22.9	72.2	120/34	1009.0
	Seaward Bay	11/13	1200	20.5	74.2	130/15	1002.0
	Westerdam	11/13	1800	24.5	74.5	060/44	1004.4
	Norway	11/13	1800	25.0	75.3	080/42	1001.7
	C6TV	11/13	1800	22.0	70.8	150/34	1004.5
	SS Guayama	11/13	1800	24.3	73.3	070/35	1005.0
	WTL479	11/14	0000	21.8	72.3	180/39	1003.0
	C6TV	11/14	0000	23.1	72.6	150/34	1001.4
	Star Grindanger	11/14	0000	22.9	72.5	100/35	1000.0
	Fredricksburg	11/14	1200	25.3	79.8	050/45	1003.0
	Cherry Valley	11/14	1300	24.3	81.5	360/40	1018.5
	Cherry Valley	11/14	1600	24.5	80.8	360/40	1005.0
	Cherry Valley	11/14	1900	24.8	80.4	040/52	1002.9
	Cherry Valley	11/14	2200	25.2	80.0	070/50	1005.5
	Endeavor	11/15	0000	24.2	82.3	360/40	1002.6
	Fredricksburg	11/15	0000	26.0	78.0	050/45	1006.0
	Endeavor	11/15	0600	24.4	81.1	060/34	999.5
	Endeavor	11/15	1200	25.2	79.8	120/40	1002.9
	unknown	11/15	1200	25.4	77.5	140/37	1007.8
	Dusseldorf Express	11/15	1500	25.4	79.9	120/42	1004.0
	Endeavor	11/15	1800	26.2	79.0	130/37	1006.8
	Dusseldorf Express	11/15	1800	26.5	79.7	120/35	1006.2
	Shelly Bay	11/15	1800	24.0	79.5	160/35	1006.0
	Hoegh Dyke	11/15	2100	24.1	85.2	340/45	1005.0
	Dusseldorf Express	11/15	2100	27.6	79.7	070/40	1006.8
	Dusseldorf Express	11/16	0000	28.6	79.7	080/37	1010.2
	ZCAQ	11/16	0000	29.9	79.7	090/34	1011.0
	Shelly Bay	11/16	0600	27.1	77.9	140/39	1006.0
	Hoegh Dyke	11/16	2100	27.3	79.7	160/58	998.0
	Mette Maersk	11/16	2100	24.6	79.6	200/36	1005.0
	Hoegh Dyke	11/17	0000	28.2	79.6	140/54	996.0
	Dusseldorf Express	11/17	0600	31.9	80.2	010/41	1005.9
	Sealand Crusader	11/17	0600	28.0	78.2	200/41	993.0
	NNAC	11/17	1200	29.0	76.0	200/45	989.5
	unknown	11/17	1200	36.3	74.7	080/45	1012.3
	unknown	11/17	1200	32.2	79.2	010/42	1002.4
	San Nicolas	11/17	1800	27.6	74.1	230/42	1002.0
	Zim Savanna	11/17	1800	27.7	77.5	300/35	1003.0
	Finnsnes	11/17	1800	30.0	72.0	---/60	-----.-
	CGM Ronsard	11/17	1800	30.5	79.4	350/35	1008.0
	Mormacsky	11/17	1800	--.-	--.-	060/37	1003.5
	unknown	11/17	1800	37.1	75.1	070/40	-----.-
	unknown	11/17	1800	35.2	75.2	070/45	1006.0
	Tropic Sun (KLHC)	11/17	2100	32.6	71.8	140/48	1000.3
	Star Evviva	11/17	2100	34.0	73.5	090/35	1000.5
	Sealand Integrity	11/17	2100	32.7	78.2	360/40	1001.0
	KLUI	11/17	2100	34.0	76.5	050/38	1010.1
	BT Navigator	11/18	0000	34.2	71.8	080/44	1003.2
	Advantage	11/18	0000	33.5	72.2	120/68	1002.5
	Tropic Sun (KLHC)	11/18	0000	33.4	72.3	110/68	998.8
	Star Evviva	11/18	0000	33.8	74.4	040/58	990.0
	unknown	11/18	0000	34.2	76.2	---/50	1002.8
	Dusseldorf Express	11/18	0000	32.5	75.1	360/42	994.2
	NNAC	11/18	0000	31.2	78.1	350/35	1002.4
	Star Evviva	11/18	0300	33.3	75.2	040/58	987.0
	Dusseldorf Express	11/18	0300	32.2	74.4	230/45	994.1
	Star Georgia	11/18	0300	36.5	74.9	110/37	1001.9
	BT Navigator	11/18	0300	34.0	71.7	070/52	1002.7
	unknown	11/18	0300	32.0	79.3	360/45	1007.5
	BT Navigator	11/18	0600	33.8	71.9	090/44	1002.8
	Star Georgia	11/18	1200	34.6	76.0	100/55	999.5
	Star Evviva	11/18	1500	32.3	77.4	320/52	1003.0
	WTEZ	11/18	1500	34.6	76.6	020/34	1001.3
	Star Georgia	11/18	1500	34.1	76.8	250/60	999.6
	San Nicolas (?)	11/18	1800	30.8	78.0	270/40	1005.0
	Star Georgia	11/18	1800	33.4	77.4	330/55	999.9
	Star Evviva	11/18	1800	32.4	78.0	320/40	1003.0
	NRKN	11/18	1800	33.9	76.6	040/35	997.0
	Sealand Discovery	11/18	2100	37.4	71.4	140/45	1012.5
	Star Georgia	11/18	2100	33.0	78.0	320/40	-----.-
	Star Georgia	11/19	0000	32.4	78.8	340/40	-----.-
	San Nicolas	11/19	0000	31.7	79.0	330/36	1007.2
	Mette Maersk	11/19	0600	33.0	77.9	350/38	1009.0
	Mette Maersk	11/19	1500	34.9	75.3	360/36	1016.0
	Zim Savanna	11/19	1800	32.7	78.2	040/35	1018.0
	DHIO	11/20	0000	30.1	78.1	360/45	1011.4

* Non-uniform averaging periods and elevations


NATIONAL HURRICANE CENTER
ATLANTIC · CARIBBEAN · GULF OF MEXICO · HURRICANE TRACK CHART
1994
1 T ALBERTO Jun 30–Jul 07
2 T BERYL Aug 14–19
3 H CHRIS Aug 16–23
4 T DEBBY Sep 09–11
5 T ERNESTO Sep 21–26
6 H FLORENCE Nov 02–08
7 H GORDON Nov 08–21
Tropical depression stage
Tropical storm stage
Hurricane stage
Extratropical stage
Subtropical depression stage
Subtropical storm stage
Position at 0000 UTC
Position and date at 1200 UTC
996mb Landfall and lowest central pressure in millibars
6 Initial position of cyclone Number 6
H HURRICANE
T TROPICAL STORM
ST SUBTROPICAL STORM
LAMBERT CONFORMAL CONIC PROJECTION
STANDARD PARALLELS AT 30° AND 60°
SCALE OF NAUTICAL MILES
993mb
999mb
996mb
999mb
1011mb
980mb
1000mb
1008mb
1000mb
972mb
979mb
997mb
1006mb
1007mb

Eastern North Pacific Hurricane Season-1994

Richard J. Pasch and Max Mayfield
National Hurricane Center
Miami, Florida

A near normal number of tropical storms and hurricanes occurred in the eastern North Pacific basin in 1994. Of the total of 17 tropical storms, nine reached hurricane strength. These numbers are very close to the averages taken since the beginning of the era of satellite observations in 1966.

The season got off to a late start. The first tropical depression, which became Tropical Storm Aletta, developed on June 18. Only the 1966 and 1968 seasons started later.

There were some other notable aspects of the 1994 season. Most of the storms formed farther to the west in the eastern Pacific basin than usual and more

1994 Eastern North Pacific Hurricanes and Tropical Storms

No.	Name	Class[a]	Dates[b]	Maximum sustained wind (knots)[c]	Lowest pressure (mb)
1	Aletta	T	6/18-6/23	45	999
2	Bud	T	6/27-6/29	40	1003
3	Carlotta	H	6/28-7/5	90	967
4	Daniel	T	7/8-7/14	55	993
5	Emilia	H	7/16-7/25	140[d]	-
6	Fabio	T	7/19-7/24	40	1002
7	Gilma	H	7/21-7/31	140[d]	-
8	Hector	T	8/7-8/9	55	993
9	Ileana	H	8/10-8/14	65	986
10	John	H	8/11-9/10	150[d]	-
11	Kristy	H	8/28-9/5	90[d]	-
12	Lane	H	9/3-9/10	115	948
13	Miriam	T	9/15-9/21	40	1002
14	Norman	T	9/19-9/22	35	1004
15	Olivia	H	9/22-9/29	130	923
16	Paul	T	9/24-9/30	40	1003
17	Rosa	H	10/8-10/15	90	974

[a]T:tropical storm, wind speed 34-63 knots.
H:hurricane, wind speed 64 knots or higher.

[b]Dates begin at 0000 UTC and include tropical depression stage.

[c]Wind speed over a one-minute span.

[d]Became a hurricane over eastern North Pacific but reached maximum intensity west of 140°W in the central North Pacific. Maximum wind estimate provided by the Central Pacific Hurricane Center in Honolulu, Hawaii. Minimum pressure is not available for these systems.

than half of the systems moved across 140°W, into the central Pacific. Three of the storms, Emilia, Gilma, and John, were powerful hurricanes in that basin. Hurricane John broke the world record for longevity of a tropical cyclone. John lasted 31 days, surpassing the previous record of 28 days set by Atlantic Hurricane Ginger in 1971. John moved over all three north Pacific tropical cyclone basins: the eastern, the central (twice), and the western (west of the International Date Line).

Only one east Pacific tropical cyclone, Hurricane Rosa, made landfall in 1994. The National Hurricane Center (NHC) received ship reports of tropical storm or hurricane force winds for only Hurricanes Ileana and Rosa. Apparently, mariners were able to avoid significant effects from other tropical cyclones over the eastern North Pacific Ocean. One likely reason was that most of the tropical cyclone activity was well offshore of the North American mainland. Notwithstanding, in the case of Hurricane Rosa, reports from a ship described below, were of great value in estimating the maximum intensity just prior to landfall.

Hurricane Carlotta

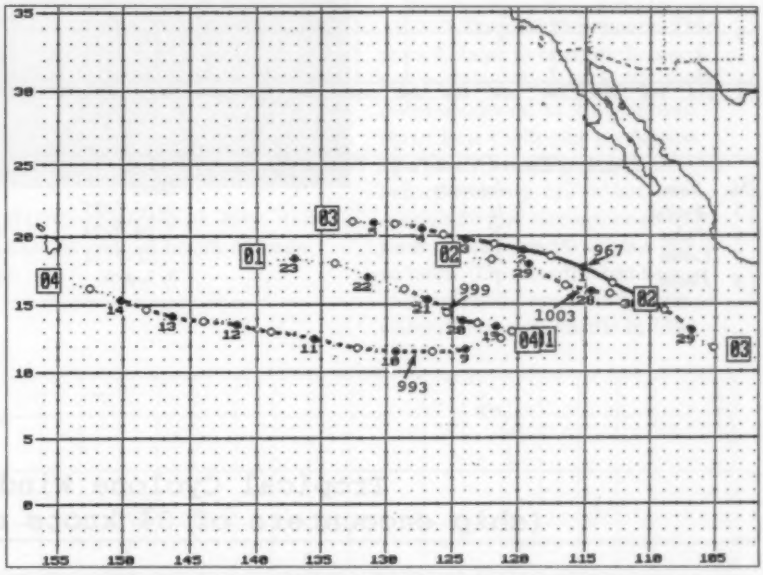
Carlotta, the first hurricane of the season, formed 430 nautical miles south of Manzanillo, Mexico on the 28th of June. It became a hurricane on the 29th, when a large eye became visible on satellite pictures. Carlotta reached peak intensity, estimated at 90 knots, at 0000 UTC July 1. This system moved on a generally west-northwestward track, and began weakening on the 2nd, eventually dissipating over cooler waters on July 5.

Hurricane Emilia

The tropical depression that was to become Emilia formed around 0000 UTC July 16 about 1500 miles southwest of the southern tip of Baja California and strengthened into a tropical storm later that same day. Intensification continued, and on the following day, Emilia moved west of 140°W as a strengthening 90-knot hurricane, and was the first of four hurricanes that acquired their peak intensity in the central Pacific. Emilia threatened the Hawaiian Islands, when it changed its heading from westnorthwest to northwest, but its primary effects were limited to some high surf in that area.

Hurricane Gilma

Gilma formed on July 21 about 1000 nautical miles south-

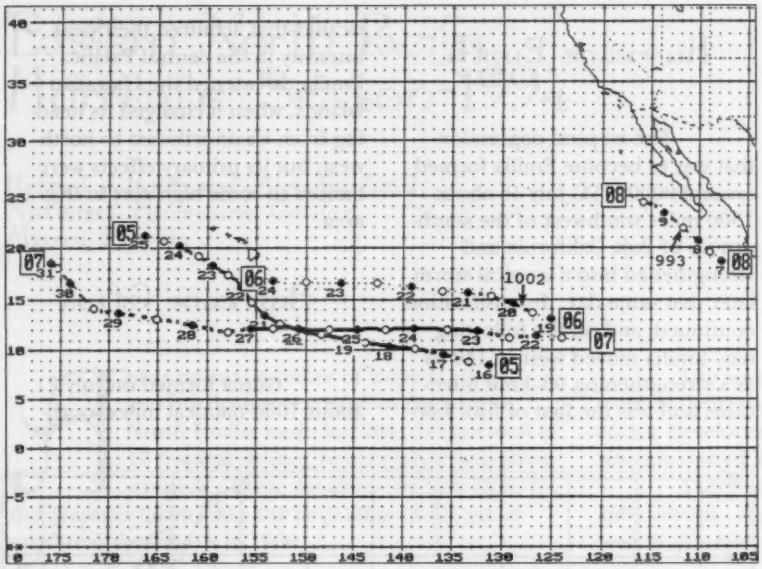


Tracks of Eastern North Pacific Tropical Cyclones, 1994 (1–4)

No.	*Name*	*Intensity*	*Dates*
1	*Aletta*	*T*	*6/18–6/23*
2	*Bud*	*T*	*6/2–6/29*
3.	*Carlotta*	*H*	*6/28–7/5*
4	*Daniel*	*T*	*7/8–7/14*

Track Chart Legend

.....	Tropical depression stage
- - - -	Tropical storm stage
———	Hurricane stage
+ + + +	Extratropical stage
●	Position and date at 0000 UTC
○–	Position at 1200 UTC
980	Minimum central pressure in millibars
06	Cyclone "Number 6"
H	HURRICANE
T	TROPICAL STORM



Tracks of Eastern North Pacific Tropical Cyclones, 1994 (5-8)

No.	*Name*	*Intensity*	*Dates*
5	*Emilia*	*H*	*7/16-7/25*
6	*Fabio*	*T*	*7/19-7/24*
7	*Gilma*	*H*	*7/21-7/31*
8	*Hector*	*T*	*8/7-8/9*

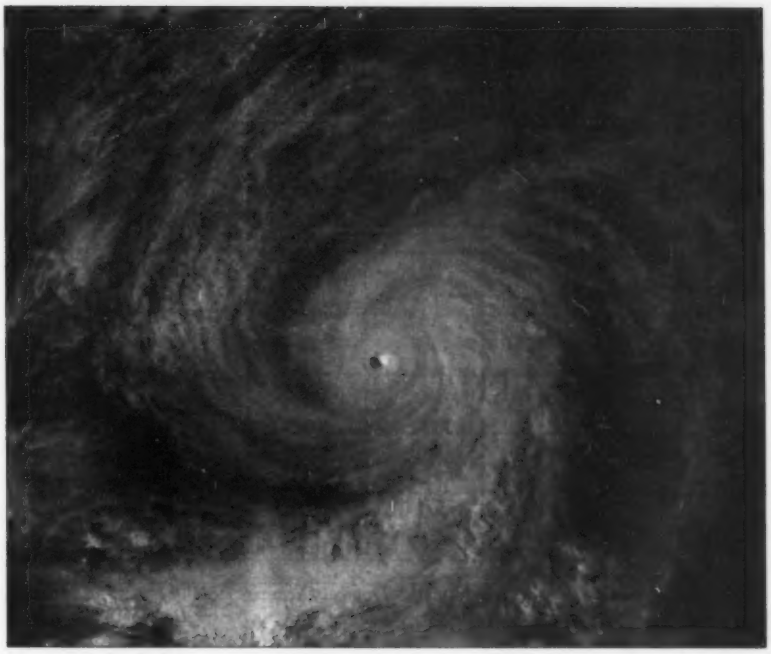
west of the southern tip of Baja California. This tropical cyclone followed a generally westward track for much of its lifetime. After becoming a tropical storm at 0000 UTC July 22, Gilma strengthened rapidly, becoming a hurricane during the following 24 hours. Gilma crossed 140°W on the 23rd with top winds near 135 knots, and still increasing. The hurricane passed well to the south of the Hawaiian Islands. Johnston Island experienced high surf and some 35-knot wind gusts while Gilma passed nearby as a weakening tropical storm.

Hurricane Ileana

On August 10, a tropical depression developed 520 miles southsoutheast of the southern tip of Baja California. It became Tropical Storm Ileana around 1 day later. Moving swiftly toward the northwest, Ileana reached hurricane strength on the 12th. It paralleled the southern portion of Baja California, remaining just far enough offshore to avoid signifi-

Tropical Cyclone Winds
(ship encounters of 34 knots or higher)

Tropical Cyclone	Ship Name	Date Mo/Da	Time UTC	Position LatN	Position LonW	Wind (kt) Dir/Speed	Pressure (mb)
Ileana	*EKYO 5*	9/12	1800	22.X	110.X	NNE/45	1007.5
	Heidelberg Express	9/12	2100	22.8	110.6	070/48	1006.0
	Nedlloyd Van Linschoten	9/12	2100	22.0	109.7	180/40	1006.5
	Heidelberg Express	9/13	0000	22.5	109.8	110/39	1007.2
	LADQ	9/13	0000	23.9	111.2	090/43	–
	Nedlloyd Van Linschoten	9/13	0000	22.7	110.8	130/40	1005.0
Rosa	*London Spirit*	10/13	1800	18.7	104.5	120/40	1004.5
	Marie Maersk	10/13	1800	20.5	106.8	080/40	996.5
	Marie Maersk	10/14	0000	20.2	106.5	090/48	992.0
	Marie Maersk	10/14	0300	20.2	106.4	130/68	987.5
	Marie Maersk	10/14	0600	20.4	106.2	16090	983.5
	Marie Maersk	10/14	0900	20.5	106.2	210/54	992.5



Visible satellite picture of Hurricane Olivia at 2300 UTC on September 25, 1994. At this time, Olivia was a major hurricane with a well-defined eye, centered, roughly 600 miles westsouthwest of the southern tip of Baja California.

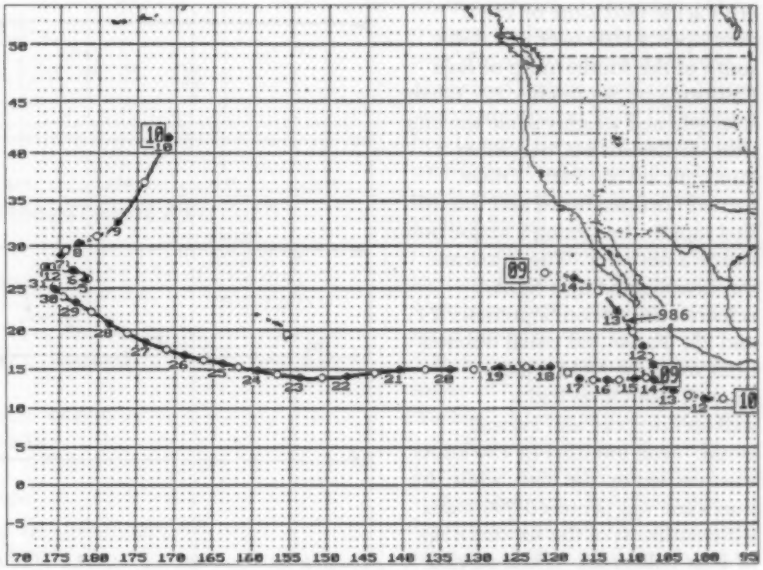
cant effects on that peninsula. Ileana soon encountered cooler waters, and weakened to a tropical storm on the 13th and to a tropical depression 24 hours later as it turned toward the west. It dissipated around 0000 UTC August 15.

Hurricane John

John had the easternmost point of origin of all the 1994 systems, near 97°W a little over 350 miles southsoutheast of Acapulco, Mexico, on August 11. For nearly 3 weeks, John moved on a heading just slightly north of due west. John became a hurricane near 134°W on August 19, then crossed into the central Pacific with winds near 100 knots. In the latter basin, John became the strongest hurricane of the season. While south of Hawaii, on August 23, a surface pressure of 929 millibar was measured by reconnaissance aircraft and John's surface winds were estimated in excess of 130 knots at this time. John traveled very far west in the Pacific, to near 178°E. As mentioned earlier, John set a new record for longevity of a tropical cyclone. However, throughout all its long traversal of the Pacific, John never made a direct hit on land.

Hurricane Kristy

Tropical Depression Thirteen-E, later to become Tropical Storm Kristy, formed about 1100 miles southwest of the southern tip of Baja California on August 28. Kristy became a hurricane just before crossing 140°W late on August 30 and strengthened to its peak intensity of 90 knots a day or so later. This was the last named eastern Pacific tropical cyclone to enter the central Pacific in 1994.



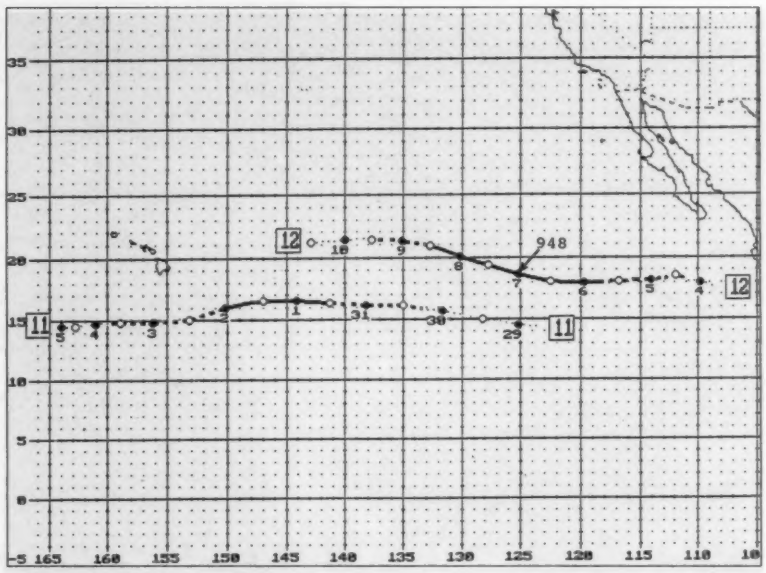
Tracks of Eastern North Pacific Tropical Cyclones, 1994 (9-10)

No.	*Name*	*Intensity*	*Dates*
9	*Ileana*	*H*	*8/10-8/14*
10	*John*	*H*	*8/11-9/10*

Kristy followed a mainly westward track, but turned westsouthwestward while in the central Pacific, passing well south of the Hawaiian Islands as a weakening tropical storm on September 2 to 3.

Hurricane Lane

The tropical depression (Fourteen-E) which eventually became Lane developed 360 nautical miles south of the southern tip of Baja California around 1800 UTC September 3. In 2 days, the system became a hurricane, while located about 550 miles westsouthwest of the southern tip of Baja California. Lane moved westward to westnorthwestward throughout its lifetime. Its maximum sustained winds reached an estimated 115 knots around 0000 UTC September 7.

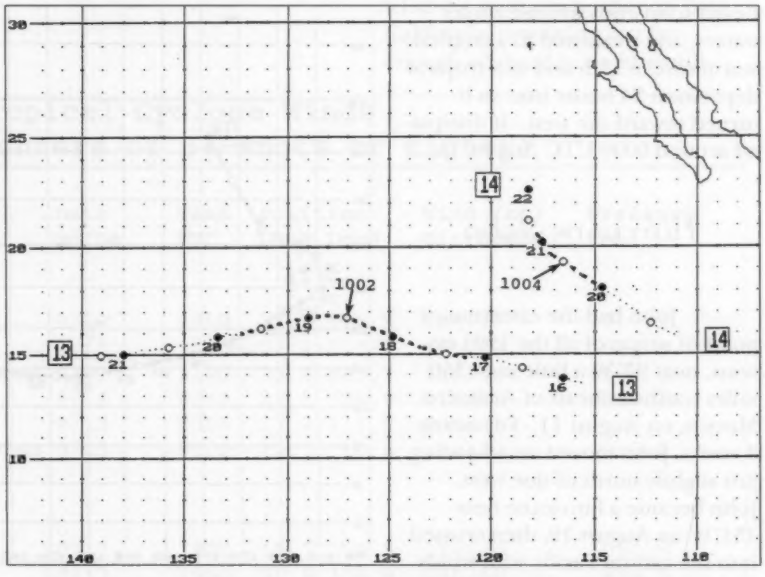


Tracks of Eastern North Pacific Tropical Cyclones, 1994 (11–12)

No.	Name	Intensity	Dates
11	Kristy	H	8/28–9/5
12	Lane	H	9/3–9/10

Hurricane Olivia

Olivia, the strongest eastern Pacific hurricane of 1994, developed a little over 600 miles south of the southern tip of Baja California on September 22. Olivia strengthened steadily while moving westnorthwestward, becoming a hurricane on the 24th. Olivia turned northwestward and intensified rapidly, becoming a major hurricane a day later. The hurricane was investigated by a NOAA research aircraft on September 24 and 25. Radar and visual observations from the NOAA plane showed that Olivia had a well–defined eye and eyewall cloud. Peak intensity of 130 knots was reached on the 25th, while the hurricane was centered 600 miles westsouthwest of the southern tip of Baja California. Olivia turned northward that day, and northnortheastward, while weakening, on the 26th. Although this movement threatened the Baja Califor-



Tracks of Eastern North Pacific Tropical Cyclones, 1994 (13–14)

No.	Name	Intensity	Dates
13	Miriam	T	9/15–9/21
14	Norman	T	9/19–9/22

nia peninsula for awhile, steering currents weakened, and Olivia made a small clockwise loop on the 27th while continuing to decrease in strength. The system weakened to a tropical storm, and turned westward, degenerating into a tropical depression on the 28th. Olivia dissipated on the 29th.

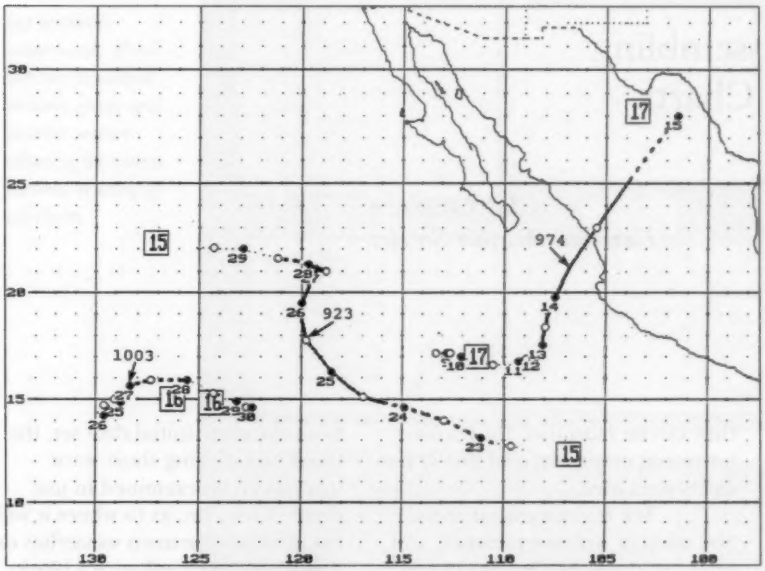
Hurricane Rosa

An area of disturbed weather located about 700 miles southsouthwest of the southern tip of Baja California formed into a tropical depression around 1200 UTC October 8. The vessel ***Green Lake***, just south of the center, reported west winds of 30 knots at 2100 UTC on that day. The depression remained rather disorganized during the next few days. However, during that period, another area of disturbed weather was approaching the tropical depression from the east. Both systems eventually combined, and under more favorable upper-level winds, the tropical depression began to intensify. Rosa reached tropical storm status at 1800 UTC October 11 and hurricane strength 24 hours later, about 300 miles south of the southern tip of Baja California. Rosa moved little for the next day or so, but then, a large mid- to upper-level trough approaching the West Coast of the United States induced steering winds which accelerated the hurricane toward the northward, then northeastward, toward the coast of mainland Mexico. A few hours before landfall, Rosa reached its maximum intensity of 90 knots with an estimated minimum pressure of 974 millibar.

The maximum winds were primarily based on reports from the ship ***Marie Maersk***, which was located very near the eye around the time of peak intensity. That ship was in Rosa's circulation for several hours and provided very useful weather information.

At 1000 UTC on the 14th, the center of Rosa hit Mexico near La Concepcion, about 60 miles southsoutheast of Mazatlan. The tropical cyclone weakened rapidly over the mountainous terrain of Mexico. The low-level circulation was dissipating at 0600 UTC October 15 near the Texas border, but moisture from the system raced northeastward over the central United States.

Five persons were reported to have drowned in Mexico due to Hurricane Rosa, and four people were reported missing. Over 100,000 people suffered partial losses of homes in the state of Nayarit. A large number of homes as well as telephone and power lines were damaged by winds in the state of Sinaloa. Rainfall totals between three and 127 mm caused flash floods and mud slides, primarily in the mountainous areas.



Tracks of Eastern North Pacific Tropical Cyclones, 1994 (15-17)

No.	*Name*	*Intensity*	*Dates*
15	*Olivia*	*H*	*9/22-9/29*
16	*Paul*	*T*	*9/24-9/30*
17	*Rosa*	*H*	*10/8-10/15*

Track Chart Legend

.....	Tropical depression stage
- - - -	Tropical storm stage
———	Hurricane stage
+ + + +	Extratropical stage
●	Position and date at 0000 UTC
○	Position at 1200 UTC
980	Minimum central pressure in millibars
06	Cyclone "Number 6"
H	HURRICANE
T	TROPICAL STORM

Mariners Guide to Assembling NWS Radiofacsimile Charts

Lee Chesneau
National Weather Service

Past issues of the *Log* have featured a "Fax Facts" section, describing NWS High Frequency (HF) radiofacsimile products produced by the National Meteorological Center's Marine Forecast Branch (MFB) in Washington, D.C. Examples were given of the suite of products for the Pacific and Atlantic Ocean, describing what the products are and how to interpret them. This column will try to convey to mariners how to integrate and display the core products for optimum use aboard ship.

The MFB fax schedule transmits upper air, surface and sea state analyses and forecasts in a logical and timely sequence. The next step is for the mariner to display the hard copies either on the bulkhead or in a chart drawer where they can be examined for consistency and continuity and finally for safety decisions.

We recommend that the 500 millibar, surface pressure, and sea state charts be displayed vertically and horizontally, both spatially and by date/time (i.e., the 500 millibar analysis, surface pressure analysis, and the 96-hour forecasts should be vertically displayed underneath respective upper air and surface analyses charts (See photo). The mariner can then piece together how and why specific synoptic scale weather features are going to impact the vessel. Displaying charts in this manner will also provide continuity in time and space for all weather systems.

Given a 500-millibar analysis and subsequent 500 millibar 48-hour and 96-hour forecasts from the same initial data set, the trend of a digging short wave trough can be examined in just three charts, i.e., as to where it will cut off from the main westerlies or contribute to or enhance a blocking pattern (see "Mariners's Guide to the 500 Millibar Chart" by Sienkiewicz and Chesneau, Winter 1995). At the same time a previous 500-millibar forecast can be compared to the latest 500-millibar analysis for its verification. This procedure can help to either enhance or diminish confidence levels in the subsequent forecast. Stepping through the same process with the surface pressure charts, some valid forecast date/time, the mariner can then tie in the relationship with the 500-millibar pattern. This is done by determining its vertical consistency and continu-

The MITAG chart (left) displays radiofacsimile charts from the NWS's Marine Forecast Branch, National Meteorological Center, Washington, D.C. The 500 millibar, surface pressure, sea state analyses and forecast charts are aligned horizontally across but vertically underneath. Products are consistent in time, space, and weather motion allowing for instantaneous viewing of all charts.

ity with intensifying or weakening trends of surface storms along with location of highest sea state conditions. This is exactly the process marine forecasters follow in the MFB to derive their final hand drawn surface pressure and sea state forecasts.

The Maritime Institute of Technology and Graduate Studies (MITAGS), in Linthicum Heights, Maryland, Maryland in its Heavy Weather Avoidance Course (HWA), teaches this approach to its students. Mariners are shown how to interpret and use MFB radiofacsimile charts to maximize avoidance of life threatening and property damaging maritime storms. By relating the 500 millibar patterns with surface weather patterns, past and future forecasts to the current analyses, the mariner leaves the course with a better understanding of how the environment will change in time, and thus make better prudent decisions with a vessel (see *Mariners Weather Log*, Fall 1994). MITAGS provides mariners with the information on how to use NWS radiofacsimile charts. For any questions or interest in the Heavy Weather Avoidance (HWA) Course at MITAGS which features NWS radiofacsimile products, you may contact Glen Paine at MITAGS at 410-859-5700.

Screwpile Lighthouses

Elinor De Wire
Gales Ferry, Connecticut

When most of us think of a lighthouse, we picture a lofty stone tower perched on a rocky headland or rising high above a long stretch of lonely beach. But lighthouse engineering was not confined to solid ground alone. Many of the world's lighthouses stand in bays and harbors and on sea-swept offshore reefs.

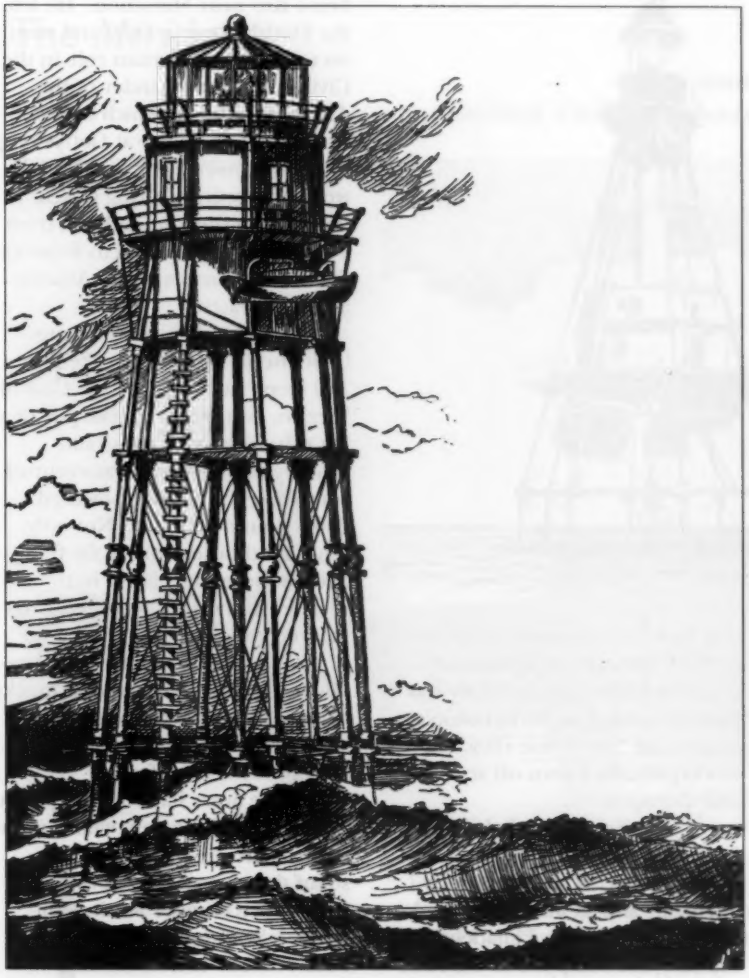
Screwpile lighthouses stand on huge iron legs screwed directly into a rock, reef, or the sea floor itself. They were first developed by an Irish marine engineer, Alexander Mitchell, whose experiments in the 1830s with methods for mooring ships led him to design a pile that could be anchored firmly in the soft, alluvial beds of bays and harbors. When Mitchell's pile design proved successful, he developed a similar design for a lighthouse at the mouth of the Wyre River in Lancashire, thus opening the door on a new era in marine engineering.

Mitchell's work was made more incredible by the fact that he developed his revolutionary designs after going blind. He had been born with poor eyesight, and by age 21 was completely blind. Despite his infirmity, Mitchell had managed to educate himself in mathematics, mechanics, engineering and science. He worked as a brickmaker in Belfast, but spent his leisure hours tinkering. His wife and son served as his eyes and helped him assemble and test his inventions.

Alligator Reef Light is example of a Screwpile lighthouse. This style light originated in England and the first one in the U.S. was built in 1843 in Black Rock Harbor, Connecticut. Today, a number still stand in mucky bays and harbors, and on the reefs and sandbars off Florida and in the Gulf of Mexico.

They assisted him in 1832 when he tested a sail he had designed for high winds. Prior to this, Mitchell had lain awake nights listening to storm winds rage outside his bedroom, and he wondered what he could do to help sailors survive in such dangerous weather conditions. He knew ships lost their ability to maneuver if their sails were ruined, so he began experimenting with designs for sails that could withstand high winds.

His experiments were not successful, but they led to a more



The original Minots Ledge Lighthouse was built in 1850 but just one year after it began operation it was destroyed by a devastating storm.

important invention. Mitchell and his wife and son were testing a sail with a flanged screw on its lower end when a gust of wind grabbed the sail and screwed it into the muck of Belfast Lough. So firmly was the screw set, Mitchell could not remove it. He returned the next day to find it still anchored, and it remained so even after a storm the following week. Mitchell had developed the screwpile.

He patented his invention in 1833, and 5 years later it was used in the construction of the Maplin Sands Lighthouse. The tower consisted of nine iron disk-footed piles – eight forming an outer octagon and the ninth as a center support – screwed 7 meters into the unstable river muck and supporting a house for the keepers with a beacon on top. Mitchell, with the assistance of his son, designed the entire structure and oversaw its construction.

The marine engineering world marveled at this technical advancement and its designer. Mitchell was extolled for his devotion to the numerous screwpile towers that were constructed in the decades following his discovery. He visited many of the sites to inspect work and cheer the crews who toiled on dangerous, wave-swept sites. Men were amazed to see Mitchell crawling on hands and knees, using his sensitive fingers, to assess workmanship, or leading the chanteys the crews sang as they marched around the great windlasses that drove in the monstrous screws.

In the United States, the first screwpile tower was built in 1843 at Black Rock Harbor in Connecticut. Capt. William H. Swift of the Army Corps of Topographical Engineers was the architect. He had traveled to England to study the Maplin Sands Lighthouse and talk with Alexander Mitchell. After the success of his 11-meter Black Rock screwpile tower, Smith felt confident and eagerly accepted the job of building a lighthouse on treacherous Minots Ledge off Cohasset, Massachusetts.

Construction of the Minots Ledge Lighthouse was difficult and costly, and only a year after it was lit, the tower was completely destroyed by the sea and its two keepers drowned. The 1851 storm that claimed it earned the memorable name "The Minots Light Storm." Investigation showed the tower's iron piles had not been properly braced and had snapped like matchsticks under the intense pressure of wind and waves.

Other screwpile lighthouses fared better. About the same time

Fowey Rocks Lighthouse, drawn by Paul Bradley Jr., stands 33.5 meters above water southeast of Key Biscayne, FL.

Minots Light was under construction, a massive screwpile sentinel was also underway in the Delaware Bay. Marine engineers, Maj. Hartman Bache and Lt. George G. Meade, were both young and energetic when they were appointed by Congress to design and build the Brandywine Shoal Lighthouse, 8 miles offshore. Alexander Mitchell sailed to Delaware to serve as a consultant on the project. The 14–meter lighthouse had 32 screw piles supporting a keeper's house and was fortified by tons of riprap dumped around its base to prevent ice floes from shearing off its legs. The pricetag was $53,317, and the beacon was lit in October 1850.

No sooner had Meade finished work in the Delaware Bay than he was sent to the Florida Keys to build a screwpile lighthouse on Carysfort Reef. More than 60 known vessels had met their doom on this shallow coral reef, including the frigate ***HMS Carysford***, for which the reef is named. A lightship had been assigned to the reef in 1824, because no lighthouse could be built there, but duty was perilous, owing to the lightship's position in "hurricane alley." It was repeatedly blown off station and damaged.

The screwpile lighthouse for Carysfort Reef had been designed by I. W. P. Lewis, a civil engineer, and its metal parts had been fabricated in a Philadelphia foundry, then shipped to the Florida Reef. Lt. George R. Meade had to make a few modifications to the design when it was discovered the coral reef was not solid but was a hard shell over sand. Meade knew the screws would not hold in sand, so he designed disks to rest on the coral crust of the reef and distribute the weight of the huge 112-foot tower.

Meade went on to build screwpile lighthouses at Florida's Sand Key, where a masonry tower had been destroyed in the Great Hurricane of 1846, and on Sombrero Key near Marathon. He left the Florida Keys in 1860 and went on to play an important role in the Civil War as commander of the Army of Potomac, which defeated Robert E. Lee's army at Gettysburg. Other engineers took up Meade's work of erecting a string of sentinels along the Florida Reef, from Fowey Rocks off Miami to Rebecca Shoal's confluence of the Atlantic and Gulf waters.

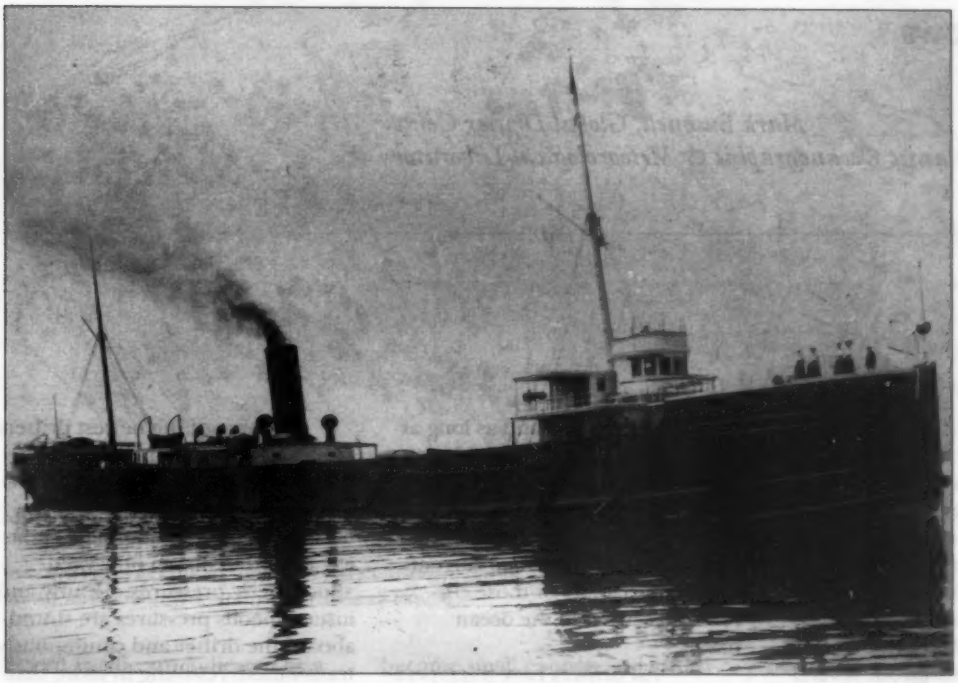
Major lighthouses were built also in the Chesapeake Bay and along the shores of the Gulf of Mexico. Mitchell's archaic pile-driving raft, with its windlass and chantey-singing crew, was eventually replaced by a steam-powered 2000–pound hammer. Not only were lighthouses built in far-flung and tempestuous places, but wharves and docks benefited from the technology.

Today, a number of screwpile lighthouses still stand in mucky bays and harbors, and on the reefs and sandbars of Florida and the Gulf of Mexico. A few in ice–prone areas have been replaced by caisson lighthouses, whose monstrous concrete platforms withstand the pressure of moving ice. Diminutive Hooper Strait lighthouse is among those that have been retired. It now stands a peaceful watch at the Chesapeake Bay Maritime Museum in St. Michaels, Maryland.

Visitors can go inside the sentinel and explore its strange, octagonal living quarters and the small beacon that juts up from the roof. The lighthouse's legs are sunk in the ground and afford a closer look at Alexander Mitchell's amazing technology. Near the base of the tower is the most fascinating relic of all—a screw from the end of a pile that was once sunk into the floor of the bay.

The *Merida*

Skip Gillham
Vineland, Ontario, Canada



During the 1970s fishermen snagged their nets on the remains of Merida. The hull sits upright and intact in 24 meters of water on the floor of the lake and is an excellent destination for scuba divers. Photograph Courtesy of Great Lakes Marine Historical Collection.

The Great Lakes bulk carrier, *Merida*, was built in 1892 during an era when ~~ow~~ steel steamers were replacing wood and, at 115 meters overall length, *Merida* was briefly noted as the largest on the inland seas.

The ship was constructed by F.W. Wheeler and Co. at West Bay City, Michigan, and apparently began service early in 1893 for the Whitney Transportation Company. It later sailed for Gilchrist Transportation and the Edgewater Steamship Co. and was supposed to move to Canadian owners late in 1916 when "Black Friday" prevented completion of the transaction.

Merida's last cargo, a load of iron ore, was consigned to Buffalo from a Canadian Lake Superior port in mid October 1916. Following a rough Lake Huron crossing, the steel freighter worked its way down the rivers and channels to Lake Erie, accompanied by the *Briton*.

As the pair approached the Pelee Passage on October 20, the winds shifted from the southwest to northeast. And, at 64 knots, they began to build mountainous seas. The captain of the *Briton*, a smaller ship, elected to seek shelter to ride out the storm, but *Merida* sailed on to its doom.

There were no survivors among the crew of 23, so no one one knows for sure what happened that night. However, one can speculate that the constant pounding of waves gradually tore loose the hatch covers. With the water sweeping the deck, it would be impossible to repair the damage and, before long, the cargo holds flooded and *Merida* was lost.

When the storm subsided, wreckage littered the area near Southeast Shoal. Some was identified as belonging to *Merida* while the rest came from the westbound coal carrier *James B. Colgate*. Only the captain survived the loss of the *Colgate*. A total of four ships and 51 lives were lost on Lake Erie in those fateful autumn hours.

Drifter News

Mark Bushnell, Global Drifter Center
NOAA Atlantic Oceanographic & Meteorological Laboratory

The drifting buoys developed at Scripps and deployed by the Global Drifter Center (GDC) have measured currents and water temperature for over a decade. These small, inexpensive drifters described in previous issues of the *Mariners Weather Log* are ideal platforms for several other types of sensors as well. In this column the suite of sensors used and planned are discussed.

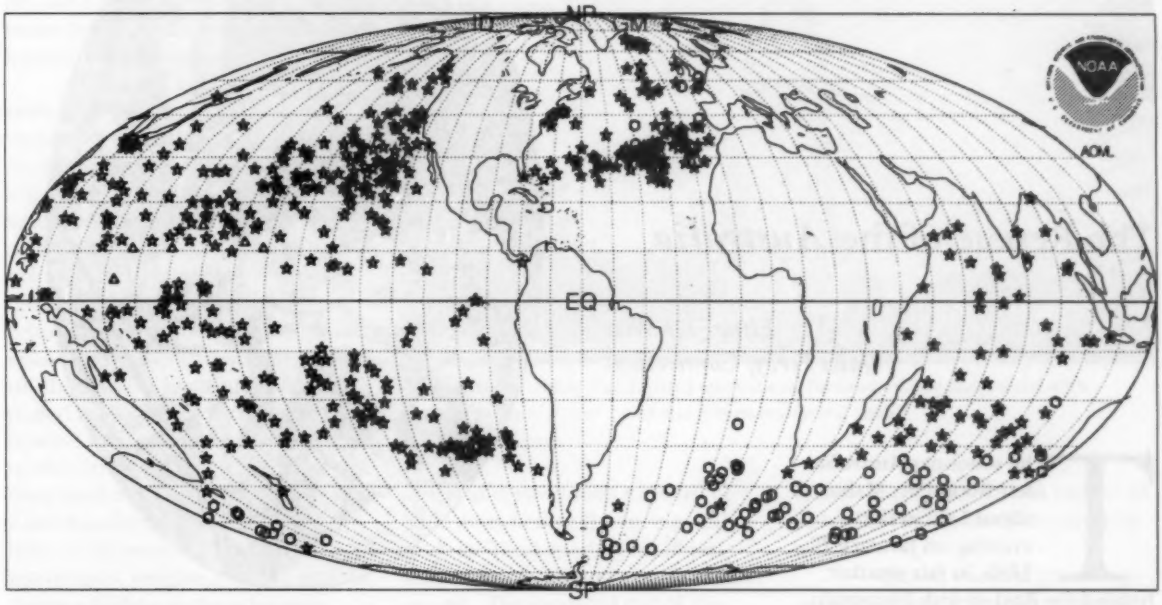
GDC drifters transmit each 90 seconds to NOAA's polar orbiting satellites. As a satellite passes overhead, data are received and a position computed for the drifter by Service Argos. Perhaps two–thirds of the satellite passes yield a position, resulting in as many as 12 fixes per day. Ocean surface currents are estimated by the different positions obtained. The large drogue and small surface float allow the drifter to follow the water with little slip and minimum wind effect. Drifters have either a submergence sensor or strain gauge used to indicate the presence of the drogue, and as long as the drogue remains attached average currents are computed to better than 0.1 knots. Velocities from all drifters have been combined to produce maps of average currents and the variability of those currents, in several of the ocean basins.

All drifters have a temperature sensing thermistor that measures the Sea Surface Temperature (SST), accurate to O.1°C. The drifter and thermistor placement are designed to minimize the effects of the daily solar warning of the drifter itself. Few temperature observations by other means exceed the ability of the GDC drifter to measure SST. Temperature data is successfully transmitted for almost all satellite passes. Because of the widespread placement and high quality data, drifter SST data is routinely used as ground truth for satellite observations and in operational forecast models. On the drifter array map, the locations of these standard drifters are indicated with a star.

Some of the newest drifters are fitted with barometers. Because the entire surface float frequently submerges, a special barometer port and sampling strategy is used to obtain only valid atmospheric pressures. Hourly and instantaneous pressures are stored aboard the drifter and continuously transmitted, resulting in more than 24 samples per day. Barometer drifters have been deployed primarily in the Southern Ocean, with a few placed in the northeast Atlantic, and soon a new array of barometer drifters will be deployed off the West Coast of the U.S. Almost one hundred barometer drifters have been deployed, and their locations are shown by circles on the map.

During the past 5 years over 70 drifters have been built with salinity sensors. A conductivity and temperature sensor is mounted at the top of the drogue (about 12 meters deep), and data from these two sensors are transmitted, from which salinity is calculated. Active salinity drifters in the

DRIFTER ARRAY AS OF JUNE 26, 1995



Drifter Array as of June 26, 1995—In this illustration, stars indicate standard drifter locations, circles show barometer drifters, and the few triangles in the west Pacific locate salinity drifters.

western Pacific are indicated by a triangle.

Global Positioning System (GPS) receivers have been installed in a few drifters and will probably be used more frequently as the cost of the receivers continues to decline. By storing positions obtained hourly, a higher resolution of currents is possible.

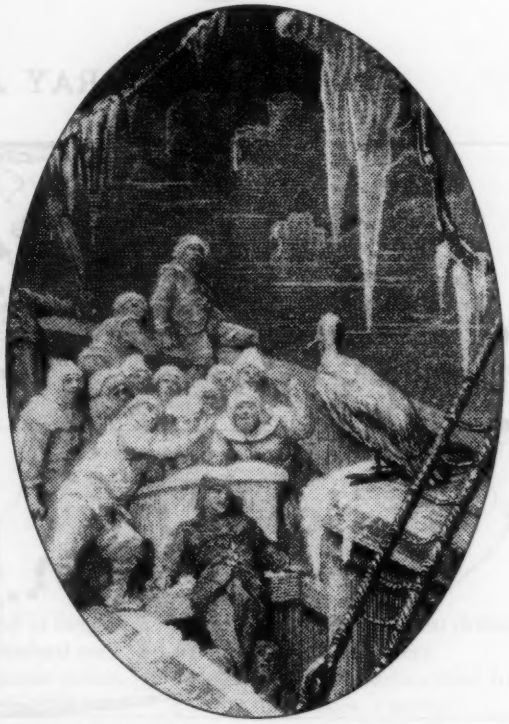
Presently under development at Scripps are wind sensing drifters. Using a technique called Wind Observation Through Ambient Noise (WOTAN), the noise level at specific frequencies is measured by a hydrophone and later converted to wind speed using relationships that have been developed previously. The method is not new, but only recently has the circuitry become small enough and affordable. Wind direction will be obtained using an electronic compass, a small wind vane mounted on the surface float, and a smart sampling strategy. An array is scheduled for deployment next year in the Labrador Sea. The same circuitry used for WOTAN wind sensing may be used for estimates of rainfall rates. Noise levels are measured at several higher frequencies and another relationship converts these observations to rain rates.

Air temperature, upwelling irradiance, and flourometers are among other sensors that have been tried or are being developed. So if you are aboard the ***Coral Islander, Discoverer, Nedlloyd Van Noort, Mitla, Malcolm Baldrige, Pacific Maru, Melbourne Star, Queensland Star, Joana Bonita, Polynesia, Pacific Islander, Strong Icelander*** or any other ships deploying GDC drifters and find a new device attached to it, don't be surprised. They're being used to measure a lot more than just temperature.

Anyone interested in helping with GDC deployments or desiring drifter information should contact Mark Bushnell at the GDC, NOAA/AOML, 4301 Rickenbacker Causeway, Miami, FL 33149. Phone (305) 361-4353, fax (305) 361-4582, telex 650745760, or Internet *Busnell@aoml.erl.gov*

The Rescue of the *Australia*

Elinor De Wire
Gales Ferry, Connecticut



And through the drifts the snowy cliffs, Did send a dismal sheen,
Nor shapes of men nor beasts we ken– The ice was all between.

The Rime of the Ancient Mariner
Samuel Taylor Coleridge, illustrations by Gustave Doré

The schooner ***Australia*** left Boothbay, Maine, about 5:00 in the evening on January 27, 1885, in fair weather, headed for Boston with its captain, J. W. Lewis, and two crewmen, Irving Pierce and William Kellar. Not long after the vessel put to sea, the weather deteriorated, and by midnight a storm was pounding southern Maine. The temperature had dropped to well below freezing. Blinding snow pelted the little schooner, and ice encased its masts, rigging and deck so heavily the men were forced to jettison the cargo. The captain considered running for the safety of Portland Harbor, but when the battered mainsail gave way under the immense pressure of its icy jacket, there was no choice other than to stand off until the storm let up.

That same night, just a few miles south of Portland, Marcus Hanna was standing watch in the fog signal building at the Cape Elizabeth Twin Lights. Both beacons were brightly lit, and the fog whistle was screaming a warning through the blizzard; but neither the lights nor the sound could penetrate the air. In the roar of the storm, Hanna did not hear the hull of the ***Australia*** grinding against the ledge and the shouts of its stranded men.

He was quite sick with a cold that evening and anticipating daylight, when he would be relieved by his assistant, Hiram Staples, and could head for the warmth of his house and bed. Staples arrived promptly just before dawn and admonished Hanna to button up and wrap a scarf about his face before starting for the house. The temperature was about 22 degrees, but with the wind howling relentlessly at 30 to 35 knots, the air felt like –20 degrees. The trek from the fog signal building to the warm kitchen sapped Hanna's strength. So deep were the drifts of snow and so powerful was the icy wind he was forced to crawl on hands and knees, using the dis-

"The Rescue of the ***Australia***" is excerpted from Elinor DeWire's new book, *Guardian of the Lights. For information on ordering the book write Elinor De Wire, Box 654, Gales Ferry, CT 06335.*

persed glow of the two beacons to navigate. His wife had been keeping watch for him and was ready with hot coffee, but first she had to pry the scarf from his face, since his warm breath had condensed inside it and frozen the wool to his beard.

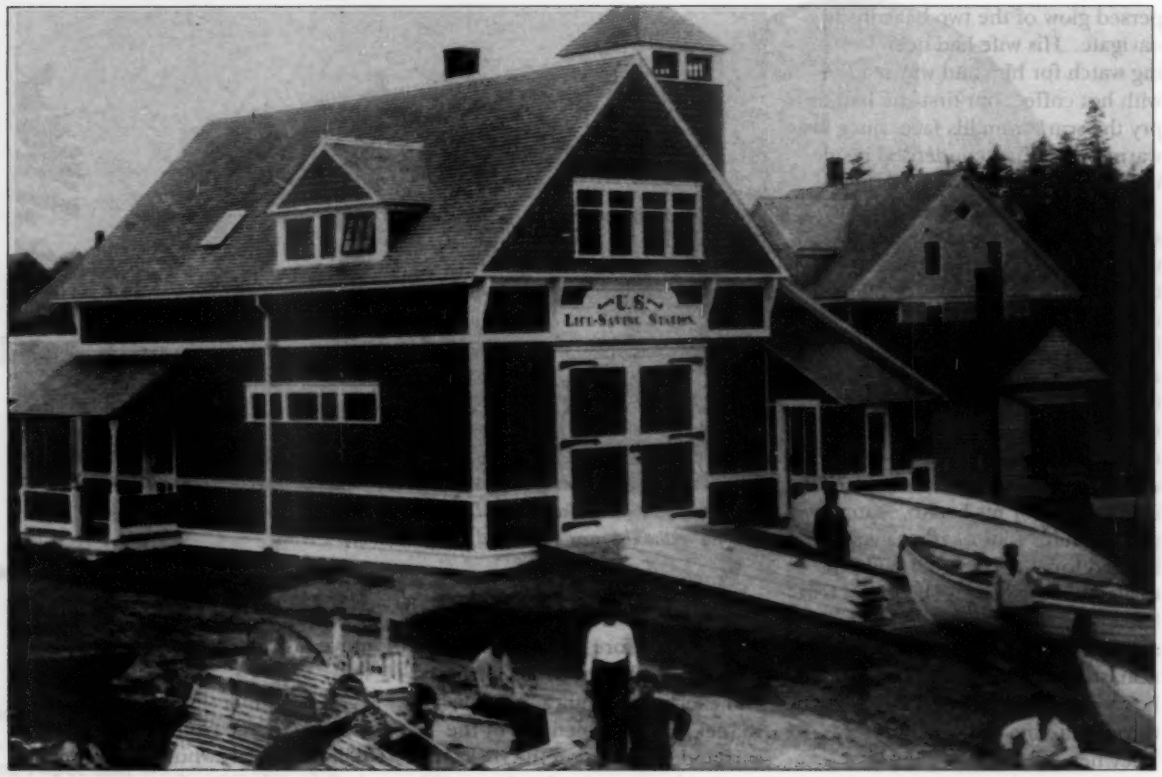
As soon as he was warmly settled in bed, Mrs. Hanna bundled up and went to each of the towers to extinguish the lamps. While wiping down the windows in the lantern of the east tower, she spied a dark silhouette on the rocky shore below, a gray shape that could only mean a ship ashore. Quickly, she returned to the house and awakened her husband. Without a selfish thought for his health, Hanna pulled on his foul weather gear and headed for the fog signal building to alert his assistant. The vessel had been pushed onshore bow first only a few hundred yards from the station, so the men decided to use a heavy rope, weighted on the end, to throw a lifeline to the schooner. They needed to work quickly, though; the tide was rising, and each wave threatened to break up the vessel and added to its already thick cloak of ice. The two crewmen were hanging in the rigging, too cold to cry out any longer and stiff from the ice that covered them. Captain Lewis had been swept away in the darkness hours before, unable to hold on until help arrived.

While Staples trudged to the nearby lifesaving station to alert the surfmen, Hanna worked his way along the slippery rocks northeast of the light towers, getting as close as possible to the schooner and hoarsely shouting encouragement to its crewmen. Stepping into the surf up to his thighs, he braced himself against some rocks and began hurling the weighted rope at the ship. Time and again he threw the makeshift monkey's fist at the vessel and saw it miss its mark or slide away before the men could grab it. Weakened by his illness and exertion, Hanna's brain began to reel. He stumbled out of the surf and lay down on the rocks to regain his strength. Staples would return soon, he thought, and the lifesavers would have a gun to hurl the lifeline.

The postcard scene of Two Lights Lighthouse in Portland, Maine was printed when postage in the U.S. was 1 cent and foreign mail cost 2 cents.

His eyes fluttered with the urge for sleep. Hanna fought to rouse himself, knowing the torpor signaled trouble. He was freezing to death; he had to get up and move, otherwise he would join the doomed men of the ***Australia***. He forced himself to his feet and began to dance wildly, flailing his arms and legs and beating himself. He became alert again, enough to see that during his brief stupor the schooner had begun to break apart under the stress of the incoming tide. Hanna waded out into the surf and renewed his efforts, casting the rope over the ship on his first try. It landed beside Irving Pierce and snagged on a spar. Pierce was barely alive, and though he saw the lifeline he was unable to move his frozen hands to save himself.

Hanna shouted encouragement to Pierce from shore, as did William Kellar, who hung in the rigging only a few feet away and could plainly see Pierce's distress. Minutes passed, then Pierce suddenly broke out of his icy shell, grasped the rope, and wrapped it about his waist. Hanna mustered what little strength he could and signaled to Pierce to drop into the sea. With the rope tied securely around him, Hanna began hauling in the man, uttering a song-like prayer to keep himself awake and pulling. Pierce bobbed up and down on his shoreward journey like a buoy loose from its moorings. Hanna feared the crewman would die on the way, yet he continued to pull and hum and pray until the shape of a man emerged from the surf at his knees. With his last ounce of strength, Hanna pulled Pierce up on the rocks and collapsed beside him. A moment later he recoiled in horror as Pierce's



U.S. Coast Guard

U.S. Lifesaving Station #10 at Cape Elizabeth, Maine as it appeared at the turn of the century when Bill Hanna rescued the Australia. Assistant Staples trekked to this station to get help for the men aboard the vessel and for Lightkeeper Hanna.

gruesome visage came into focus: The man's eyes were iced shut and his jaw was frozen in a silent scream, with his lips blue and swollen.

Crying out to heaven for mercy, Hanna pulled himself up, untied the rope from around Pierce's body, and positioned himself in the boiling surf a second time. Kellar was still able to move and answered Hanna's reassuring call. The rope was thrown a dozen times before it landed within reach of Kellar, and when he had prepared himself for the horrid trip through the surf, he signaled Hanna and leaped into the turbulent water. Hallucinations racked Hanna's mind as he hauled the rope– hazy pictures of men walking on the sea and ships righting themselves and floating away under sunlit skies. The din of wind and surf seemed to grow farther away with each pull of the rope, and Hanna felt himself floating, drifting, sleeping. . .

Staples loosened the bloody fingers locked dutifully on the rope and lifted his comrade tenderly, carrying him over the rocks as one might carry a sleeping child. The rope was taken by other hands, those of the U.S. Lifesaving Station at Cape Elizabeth, and Kellar was brought ashore safely, though as ghastly in appearance as his crewmate, Pierce. All three men – Pierce, Kellar, and Hanna – were taken temporarily to the warm fog signal building, since the storm was still too wild to risk a trek to the house. Their frozen clothing was cut off, and treatment was begun for hypothermia. Hanna roused first and was carried by his wife and Staples to the house, where he was put to bed, his wife fearing pneumonia. A mere 2 days later he was up again, however, tending to the lights and assisting Staples with getting the rescued crewmen to Portland by sled. For his bravery and unselfish effort, Hanna received a gold lifesaving medal.

The USS *West Point*

Teresa Fremaux
The Mariners' Museum
Newport News, Virginia

Troops strain against the rails as they return from the war in this photograph taken aboard the USS ***West Point*** as it sails into Newport News, Virginia on August 25, 1945. The photo is part of an exhibit commemorating the 50th anniversary of the end of World War II.

"The Hampton Roads Port of Embarkation" focuses on the troops, supplies, wounded soldiers and Italian and German prisoners of war that passed through the port from 1942 to 1946. Drawn from the port's archives of more than 15,000 negatives and photos, the exhibition also documents the role of women in the war effort. Wartime artifacts—uniforms, weapons, war bond pamphlets and posters—will also be displayed. The exhibition will join one on the role of naval intelligence, "Carriers, Codes and Silent Ships" through Spring 1996.

Sea State Products

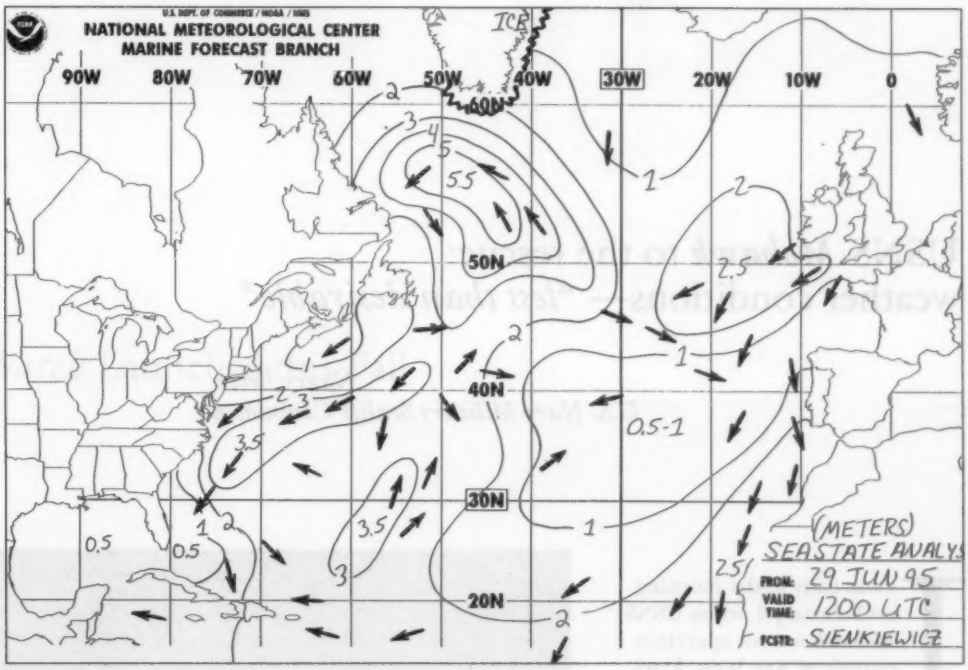
Lee Chesneau
Marine Forecast Branch

One of the greatest hazards to a vessel's safety are dangerous sea state conditions. Masters are responsible during transoceanic crossings with crew safety and ensuring that the ship and its valuable cargo arrive at destination ports intact, while meeting tight schedules. Since the turn around time in each port is usually less than 24 hours, the duration of encounter for adverse or slowing seas must be minimized.

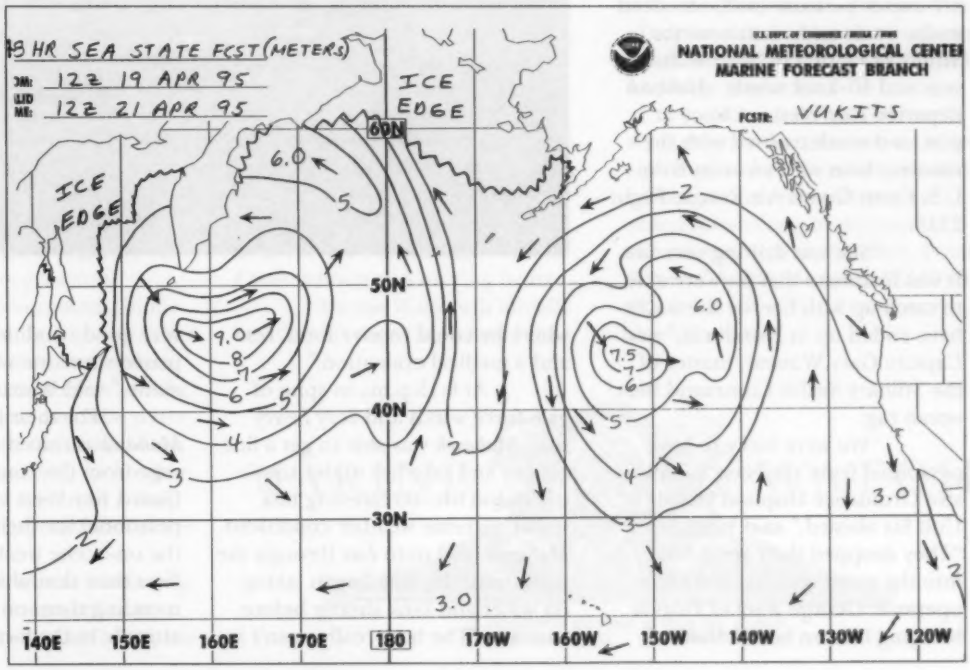
The Marine Forecast Branch (MFB) issues one surface analysis a day for each ocean (12Z in the Atlantic Ocean and 00Z in the Pacific Ocean) and two 48-Hour Sea State Forecasts each day. The analyses are prepared using ship reports and plotted in meters, along with reported primary swell direction. The data is overlaid with a 12-hour surface pressure forecast from the previous forecast model run which is valid at either 00Z or 12Z, the same time of the reported observation. The analyst also has a short range significant wave height forecast (12 hours) from the US Navy and NOAA as guidance. From the same 00Z and 12Z forecast model guidance, 48 hour significant wave forecasts are prepared and disseminated. The Sea State analyses and Forecasts when viewed with the same synoptic Surface Analyses and 48 Hours Surface Forecasts help vessels make timely course and speed adjustments to avoid hazardous conditions and minimize exposure to slowing conditions.

Sea State Analysis...This product is generated once a day per ocean (12Z for the Atlantic and at 00Z for the Pacific) and depicts solid contour intervals of 1 meter along with primary swell direction arrows. Where appropriate, maximum and minimum combined wave height values (approximately 1/3 the height of the wind wave added the height of the swell wave) are centrally depicted and underlined with the abbreviation of "MAX" or "MIN" under or adjacent to the maximum or minimum values. The primary swell direction arrows are based on ship observations. Ship reports are viewed along with the Navy and NOAA significant wave forecast models as a first guess for contour guidance. The Sea State Analyses highlight areas of significant combined sea and swell wave heights. During the winter, the ice edge is depicted as a bold jagged line. When viewed together with the surface analyses, the user has a complete picture of surface weather conditions in a timely manner.

48 Hour Sea State Forecast...These forecast products are generated from 00Z and 12Z for each ocean and will be valid at 00Z and 12Z. The forecasts are based on the forecast model runs from the Navy and NOAA. The combined sea heights are depicted in solid contours of 1 meter increments with maximum or minimum combined sea state values underlined with the abbreviation of "MAX" or "MIN" under or adjacent to the values. Also, the ice edge is displayed as a bold jagged line during the winter. Similar to the Sea State Analyses, these products provide a complete picture of forecast surface conditions when used in conjunction with the 48-Hour Surface Forecasts. The 48- Hour Sea State Forecasts highlight areas of significant combined sea and swell wave heights. Issued in a timely manner, the 48-Hour Sea State Forecasts significantly aid in the independent decision making process of heavy weather avoidance and thus minimize the duration of encounter with slowing or potentially damaging conditions.



A Sea State Analysis (above) is valid for June 29, 1995 at 1200 UTC. The 48-hour Sea State Forecast (below) was prepared at 1200 UTC on the 19th of April 1995 and is valid on April 21, 1995 at 1200 UTC.



USNS *Mohawk* to the rescue: weather conditions— *"less than desirable"*

Nancy Breen
U.S. Navy Military Sealift Command

It was early in the morning on February 4, when USNS ***Mohawk*** was on operation outside of Key West, Florida, that the U.S. Coast Guard's All Point Alert was heard over the ship's radio. The mv ***Lutz***, a 7-meter pleasure craft, was dead in the water and adrift near the Straits of Florida in 3- to 4-meter seas and 40-knot winds. ***Mohawk*** departed Key West sea buoy at 1 p.m. and rendezvoused with the runaway boat with an assist from U.S. Coast Guard Air Rescue Flight 2115.

"She was drifting very fast. It was fortunate that we were able to catch up with her, or she might have ended up in Honduras," said Captain Gary Wanzor, master of the Military Sealift Command fleet ocean tug.

"We were lucky to have personnel from the Navy's Explosive Ordinance Disposal Mobile Unit Six aboard," said Wanzor. "They dropped their small boat into the water and rescued ***Luz***'s operator, George Ruel of Florida, bringing him on board ***Mohawk*** where he could receive food, rest and a medical evaluation."

At 6:15 p.m., in spite of gale force winds and very heavy seas, ***Mohawk*** was able to get a line on ***Luz*** and take her under tow—a tricky and life-threatening task under extreme weather conditions. ***Mohawk*** held onto ***Luz*** through the night until the boat began taking on water and sank shortly before sunrise. "The boat really wasn't in very good condition. I was surprised someone would take her out alone," said Wanzer.

For their heroic efforts, ***Mohawk*** received a bravo zulu message from the commander of Coast Guard Key West chiding the tug's personnel for their description of the on-scene weather conditions as "less than desirable" and commending them on their "...can do attitude in the face of adversity."

Marine Watch Launches this Fall

A new quarterly journal, *Marine Watch*, covering "events occurring on, under, and over the oceans of the world," will debut this fall.

John Grissim, the journal's publisher and editor, says that *Marine Watch* will be geared to an informed audience.

"On the one hand are scientists, meteorologists and researchers in government, industry and academia, and on the other are professional mariners, sailors, commercial fishers, surfers, divers, shipwreck hunters, and blue water adventurers," says Grissim. "Both have a lot to share with each other and both have in common a deep knowledge and appreciation of the marine world."

Grissim, who is producing *Marine Watch* from an office in Point Reyes Station, California, has spent 3 years preparing for the journal's launch. Author of seven books, he is also a longtime surfer, fisherman, diver and lover of the ocean. He edited an Australian surfing magazine, *Tracks*, and was on the dive team that discovered and salvaged the $20 million Spanish treasure Galleon ***Concepcion***, north of the Dominican Republic in 1978. He's crewed on West Coast salmon and herring boats.

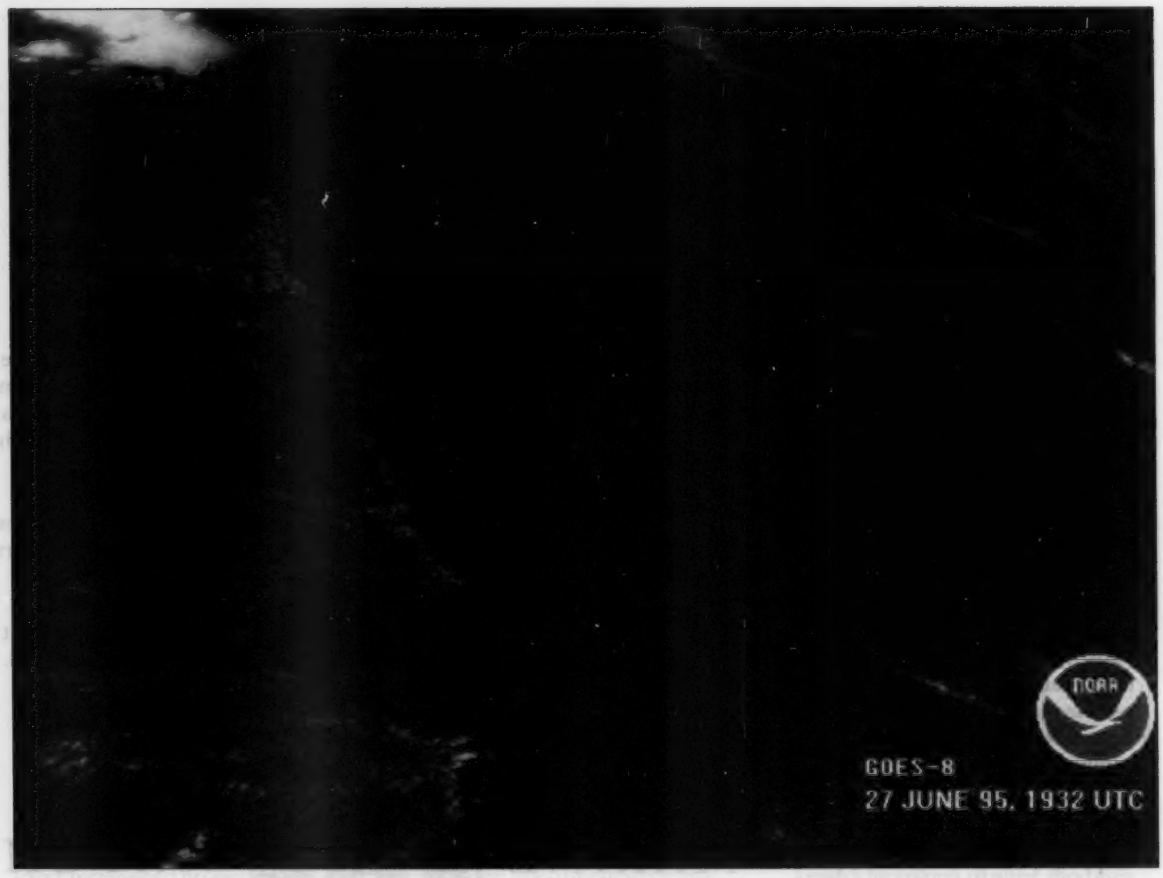
Marine Watch will initially be 16 to 20 pages in size and feature in-depth reporting on marine related news from a wide spectrum of topics: shipwrecks, shark attacks, sea floor exploration and high tech undersea research.

Grissim invites readers to send news of their marine activities, sightings and experiences. Readers wishing to receive information about subscribing to the journal should mail to P.O. Box 810, Point Reyes, CA 94956. (415) 553-8700. Fax (415) 663-8784. Email: *marwatch@nbn.com*

MARINE WATCH™

A quarterly journal of marine events

A View of the Shuttle Atlantis Launch



This image from the GOES–8 satellite operated by the National Oceanic and Atmospheric Administration was taken on June 27, 1995, at 1932 UTC. The image shows Cape Canaveral, Florida, as the Space Shuttle Atlantis was launched by the National Aeronautics and Space Administration. Contrails from the shuttle are visible from the satellite, which is located 22,300 statute miles over the Equator at 75°W. Photograph courtesy of NOAA.

Throw your trash overboard, and you could be dropping a bundle.

It's dark. You think nobody's watching. Why not toss that plastic trash bag overboard? Because if you do, you're throwing away a lot more than just the day's garbage. You're committing a class D felony, now punishable by imprisonment for up to six years and a corporate fine of up to $500,000.

Why the new penalties? Because our oceans aren't capable of absorbing unlimited amounts of trash. And a lot of people are tired of finding other people's garbage on their beaches.

So stow your trash on board for proper disposal on land. It's an idea the whole world can live with. And it can save you a bundle.

To find out more, write: The Center for Marine Conservation, PSA-CM, 1725 DeSales Street, N.W., Suite 500, Washington, D.C. 20036.

A public service message from:
The Center for Marine Conservation
The National Oceanic and Atmospheric Administration
The Society of the Plastics Industry

History's Deadly Atlantic Hurricanes

Edward Rappaport
Jose Fernandez-Partagas
National Weather Service

These selections have been excerpted from NOAA Technical Memorandum NWS-NHC 47: The Deadliest Atlantic Tropical Cyclones, 1492-1994. This report is a detailed study of the most devastating tropical cyclones throughout our recorded history and an excellent bibliography of hurricane source material as well. It is available from the National Technical Information Service, U.S. Department of Commerce, 5285 Port Royal Road, Springfield, Virginia 22151

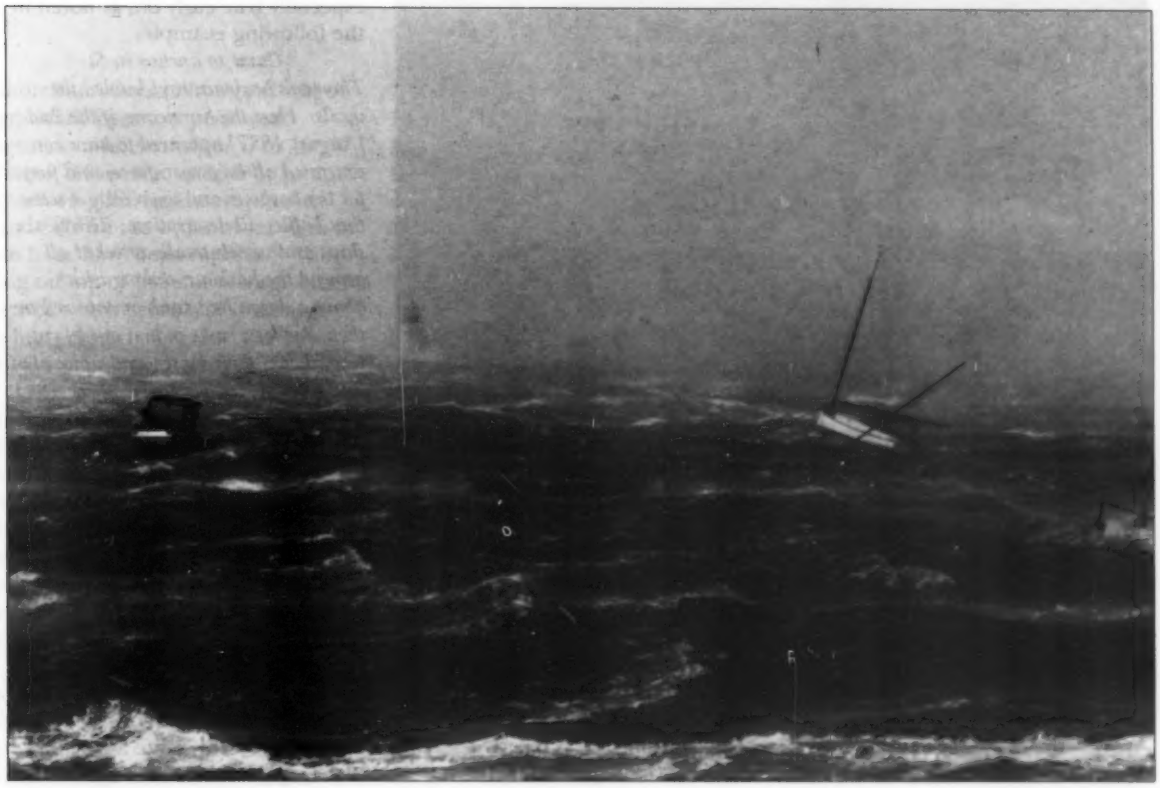
Perhaps the first human record of Atlantic tropical cyclones appears in Mayan hieroglyphics. By building their major settlements away from the hurricane-prone coastline, the Mayans practiced a method of disaster mitigation that, if rigorously applied today, would reduce the potential for devastation along coastal areas.

Many storms left important marks on regional history. In 1609, a fleet of ships carrying settler from England to Virginia was struck by a hurricane. Some of the ships were damaged and part of the fleet grounded at Bermuda. The passengers became Bermuda's first inhabitants and their stories helped inspire Shakespeare's writing of *The Tempest*.

Tropical cyclones destroyed several otherwise invincible colonial armadas. The French lost their bid to control the Atlantic coast of North America when a 1565 hurricane dispersed their fleet, allowing the Spanish to capture France's Fort Caroline near present-day Jacksonville, Florida. In 1640, a hurricane partially destroyed a large Dutch fleet apparently poised to attack Havana. Another naval disaster occurred in 1666, to Lord Willoughby (the British Governor of Barbados) and his fleet of 17 ships and nearly 2,000 troops. The fleet was caught in a hurricane near the Lesser Antilles. Only a few vessels were ever heard from again and the French captured some of the survivors. These 1640 and 1666 events secured more or less, control of Cuba by the Spaniards and Guadeloupe by the French. More than two centuries later, commenting on the Spanish-American War, President McKinley declared that he feared a hurricane more than the Spanish Navy. McKinley's concern translated to a revamped United States hurricane warning service, forerunner of today's National Hurricane Center (NHC).

Some historical weather events left scars. In 1495, the small town of Isabella, founded on Hispaniola by Columbus, became the first European settlement destroyed by a hurricane. In 1886 the town of Indianola, Texas, was destroyed by a hurricane and was never rebuilt. The 1900 "Galveston Hurricane" severely damaged much of that city and, with it, Galveston's preeminence as the financial capital of that part of the country.

The period from 1492 to 1994 has seen a large and widespread increase in Atlantic coastal population. Available records, however, suggest that the population on the Atlantic was the most vulnerable to storms through the 18th century. These shipborne explorers, emigrants, combatants, fishermen, traders, pirates, privateers, slaves, and tourists made up the crews and passengers on the uncounted, but enormous number of local and transatlantic sailings. Most of the ships travelled to or from the ports of Spain, France, Great Britain, and the Netherlands.



Hurricane Carol at its peak in Newport, Rhode Island on August 31, 1954. Hurricane Carol was responsible for 60 deaths. Photo by Raph M. Arnold of Newport, Rhode Island and courtesy of the Providence Journal Company.

They usually proved no match for the intense inner-core region of the severe tropical cyclone.

"It is doubtful if any sailing ship or any man aboard survived in this sector of a really great hurricane."–I.R. Tannehill

In fact, in 1825, "more than five percent of the vessels in the [West] Indies navigation were lost due to shipwrecks; the biggest part due to bad weather..."–R.F. Marx.

The total number of ship-related casualties associated with Atlantic tropical cyclones is unknown, but there are clues. Some perspective on the magnitude of ship losses worldwide is gained by realizing that on the coast of England alone there have been a minimum of 250,000 wrecks! On the other side of the Atlantic, near New England, it was estimated that three out of every five sailors drowned during the period 1790 to 1850. Of course, many of these disasters were unrelated to the weather, while others are attributable to the brutal, cold storms of the North Atlantic winter rather than to tropical cyclones. Still, an account of one 17th century hurricane indicates the great magnitude of some losses blamed on tropical cyclones: *By those kind of Tempests the King hath lost at several times near 1000 sail of ships.*–D.M. Ludlum.

Similar disasters continued for another two centuries. Even as late as the 1830s: *...the annual loss of life, occasioned by the wreck or foundering of British vessels at sea, may, on the same grounds (i.e., 'the boisterous nature of the weather and the badness of the ships'), be fairly estimated at not less than One thousands persons in each year....*"–Parliament Select Committee, 1839).

Steamship voyages contributed increasingly to the number of lost ships during the latter half of the 19th century. In 1875-76,

Aftermath of the 1935 Hurricane in Florida. A U.S. Coast Guard photograph.

"heavy weather" was blamed for the loss of 176 steamships. Over a longer period, 1840 to 1893, 7,523 people perished in 125 North Atlantic steamship disasters of all types.

The large number of ship losses was partially a consequence of the great number of ships that inadvertently encountered storms. W.C. Redfield's analysis a year after the 1845 hurricane off the U.S. mid Atlantic coast contains, on one weather map, information from the logs of more than 50 ships within about 450 miles of the storm's center. There were likely other vessels in that area. Redfield suggested that the then-expanding electric telegraph could be used in the Atlantic ports of the United States to alert mariners of approaching bad weather. Unfortunately, occasional ship disasters related to Atlantic tropical cyclones continued into the early 1900's. Further technological advances in meteorology, communication, navigation, and the seaworthiness of such ships makes such losses infrequent today.

Moreover, for centuries there were virtually no official records on lost ships.

While losses over open waters have decreased of late, rapid growth of coastal communities over the past 500 years has meant an ever-increasing population at risk to tropical cyclones. As at sea, relatively primitive communication methods increased the possibility of disaster near the shoreline. Not until 1909 was the first *in situ* ship report of hurricane conditions received in time to assist coastal preparations.

There are two primary components to the danger near the shore, coastal ship losses and storm surge disasters. It is estimated that 98% of the ships lost in the Western Hemisphere to 1825 wrecked in water no deeper than 10 meters. Proper disposition of many of these cases is uncertain. Undoubtedly, many mariners lost their lives while staying with their vessels until it was too late to reach safety. This seems especially true early on, as noted in the following example.

Came to anchor in St. Thomas's harbour, and landed the mails. Here the hurricane of the 2nd [August 1837] appeared to have concentrated all its power, force, and fury; for the harbour and town were a scene that baffles all description. Thirty-six ships and vessels totally wrecked all around the harbour, among which about a dozen had sunk or capsized at their anchors; some rode it out by cutting always their masts, and upward of 100 seamen drowned....W. Reid, 1841.

In contrast, today's early warning system usually results in little or no loss of life aboard vessels that wreck on a coast or in a marina. In 1992 Hurricane Andrew, for example, only two boating-relating deaths occurred in southeast Florida despite boat damage estimated at $0.5 billion.

Storm surge, occasionally reaching heights of 7 to 10 meters, has been responsible for some of the largest losses of life associated with tropical cyclones at the coastline. Storm surges is the rise of water caused by the wind and pressure forces of a hurricane. These forces induce currents in the water. While the hurricane is in deep water, these currents produce little storm surge because converging water and the subsequent piling up is compensated by currents at greater depths moving water away. However, as the hurricane moves onto the continental shelf and makes landfall, the compensating currents are eliminated by the slope of shelf and the shoreline, and the converging water rises. This rising water may over-top barrier islands or be funneled into bays and estuaries. In many cases, maximum storm surge heights measured relative to mean sea level have been recorded at the head of bays or even inland away from the

shoreline. Generally, storm surge gradually rises to a peak and returns to normal, all in 6 to 12 hours. However, intense or rapidly-moving hurricanes, rapid rises and falls on the order of minutes to an hour have been reported. Riding on top of the storm surge are waves which cause major damage when they break against the structures.

Poor communication for many years left coastal communities virtually without warning of storm surge. In the United States, storm surge is blamed for 90% of hurricane-related fatalities. Even with the many technological advances, much of the burgeoning coastal population of the Americas remains vulnerable to storm surge.

Inland communities are susceptible to tropical cyclone catastrophes. There, fresh-water flooding from excessive rainfall can lead to large numbers of deaths by drowning.

The largest loss of life from Atlantic tropical cyclone occurred in the Lesser Antilles in mid October 1780 during the Great Hurricane. Estimates indicate that around 22,000 deaths occurred in that storm, with a total of about 9,000 lives lost in Martinique, 4,000-5,000 in St. Eustatius, and 4,326 in Barbados. Thousands of death also occurred offshore.

The second largest loss (the largest in the United States) came during the 1900 Galveston Hurricane. Just after the storm, the Governor of the State of Texas estimated 12,000 fatalities, but the storm summary of Ousley (1900) provides information supporting their "official" estimate of at least 8,000 lives lost. Three other storms killed around 8,000 people; 1974 Hurricane Fifi in Honduras; a 1930 hurricane in the Dominican Republic; and 1963 Hurricane Flora in Haiti and Cuba. In all, there were 39 instance of at least 1,000 fatalities among the 144 cases in which at least 100 lives were lost. The available documentation indicates that whenever there was a large loss of life from tropical cyclones, the predominant cause of death was drowning, not wind or wind blown objects or structural failures.

Figures show that the number of deaths stratified by a 100-year periods which indicates that the number of deaths generally increase with time. The 1700's were an exception. Then, maritime losses between 1760 and 1790 dominated the relatively large total. The 71,000 deaths in the 1900's occurred despite improvements in hurricane forecasting, and communication and warning systems. The increase appears to be related to the increased population at risk along the coast and inland.

It is interesting that over 90% of the offshore losses occurred more than 200 years ago (before 1790), as did all 12 offshore losses of more than 1,000 people. For the continental United States, the Galveston storm was responsible for about one-third of the deaths.

The areal totals indicate a large death toll across the region. They do not, however, adequately reflect the threat of the individual intense hurricane. We note that the five tropical cyclones--Great Hurricane (1780), Galveston (1900), Dominican Republic (1930), Flora (1963), Fifi (1974)--accounted for about one-third of all the data on deaths has been found. In fact, the 10 deadliest storms, while representing less than 0.2% of all tropical cyclones since 1492, account for almost one-half of the deaths.

These statistics point to the tremendous repercussions that small track changes have had (and will have) on population centers at risk from a potentially deadly storm. A shift of about 50 miles in the track of the 1900 Galveston hurricane could have meant far fewer deaths on that vulnerable island and (hence) overall. On the other hand, because of the growing population, there is an increasing number of highly susceptible regions which, only so far, have escaped such a catastrophic event. Damage statistics also illustrate this point. In 1992, Hurricane Andrew caused around $25 billion damage in South Florida. An estimate indicates that a 20 mile northward shift of about 40 miles could have resulted in two to three times that much damage. Alternatively, a southward shift of about 40 miles could have resulted in a negligible monetary loss to mainland Florida (but additional problems, including possible loss of life, for the less-populated Florida Keys).

The total number of deaths associated with Atlantic tropical cyclones of the past five centuries is likely much larger than implied by the data. While it is likely much larger than implied by the data. While it is a statistic that cannot be specified with confidence, a range for total loss can be estimated.

NATIONAL WEATHER SERVICE VOLUNTARY OBSERVING SHIP PROGRAM
NEW RECRUITS FROM 01-APR-95 TO 30-JUN-95

NAME OF SHIP	CALL	AGENT NAME	RECRUITING PMO
ALLIGATOR BRAVERY	3FXX4	MITSUI OSK LINE AMERICAN INC	SEATTLE, WA
ALLIGATOR STRENGTH	3FAK5	MITSUI OSK LINE AMERICAN INC	SEATTLE, WA
ANASTASIA	9HOZ	MERCY SHIPS	MIAMI, FL
ATLANTIC CARTIER	C6MS4	ATLANTIC CONTAINER LINE	NORFOLK, VA
BAUNE	LAPI4	TORVALD KLAVENESS & CO	MIAMI, FL
BLACK SEA	C6SX	ECUADORIAN LINES INC	NEWARK, NJ
CHESAPEAKE CITY	WCYS	% KEYSTONE SHIPPING CO.	SAN FRANCISCO, CA
CHILEAN EXPRESS	3EME7	FLEET MANAGEMENT LTD	NORFOLK, VA
COLUMBIA BAY	DVBH	NYK LINE NORTH AMERICA INC	SEATTLE, WA
CONCHO	KCZC	SABINE TOWING AND TRANSPORT	MIAMI, FL
COURAGEOUS	3FQR4	TEN-HU CARGOCEAN MANAGEMENT CO., LTD.	NORFOLK, VA
CROWN PRINCESS	STKP	PRINCESS CRUISES	MIAMI, FL
CSK UNITY	9VPU	TAI CHONG CHEANG STEAMSHIP CO. LTD.	SEATTLE, WA
DIAMOND STAR	VCBW	RIGEL SHIPPING CANADA INC.	NEW ORLEANS, LA
DOLPHIN IV	HCOG	DOLPHIN CRUISE LINE	MIAMI, FL
EVER GREET	3FZQ2	TATSUMI SHOKAI CO., LTD BLDG	NEWARK, NJ
EVER LINKING	3ERJ2	EVERGREEN MARINE CORP	SEATTLE, WA
FAIR PRINCESS	FAIR	PRINCESS CRUISES	MIAMI, FL
FEDERAL FUJI	ELPQ5	NORTON LILY INTERNATIONAL INC.	NEWARK, NJ
FIORA TOPIC	ELDY9	DALMORE CORP.	MIAMI, FL
GOLDEN PRINCESS	BIRK	PRINCESS CRUISES	MIAMI, FL
GUADALUPE	KSHF	SABINE TOWING AND TRANSPORT	MIAMI, FL
HANJIN COLOMBIA	3FTF4	HANJIN SHIPPING COMPANY	SAN FRANCISCO, CA
HANJIN SEATTLE	D9SF	HANJIN SHIPPING COMPANY	SEATTLE, WA
HARBOUR BRIDGE	ELJH9	K-LINE AMERICA INC	SEATTLE, WA
HAVELLAND	DQET	ANDERS WILLIAMS SHIP AGENCY	NORFOLK, VA
HOLCK LARSEN	GBO8	LARSEN & TOUBRO LTD. SHIP GRP, BAKHTAWAR	CLEVELAND, OH
HORIZON	ELNG6	CELEBRITY CRUISES INC	MIAMI, FL
HYUNDAI ADMIRAL	D8EU	HYUNDAI AMERICAN SHIPPING AGENCY	SEATTLE, WA
HYUNDAI TACOMA	P3ZH4	HYUNDAI AMERICA SHIPPING AGENCY	SEATTLE, WA
IWANUMA MARU	3ESU8	CHIBA SHIPPING CO. LTD	SEATTLE, WA
JADE STAR	VCDR	RIGEL SHIPPING CANADA INC.	NEW ORLEANS, LA
JUFU	3EUZ6	NYK LINE N.A. INC	SEATTLE, WA
KAPITAN KONEV	UAHV	FESCO AGENCIES N. A.	SEATTLE, WA
KAPTAN CEBI	TCUT	PEGASUS CO.	MIAMI, FL
LEADER	KMLD	SABINE TOWING AND TRANSPORT	MIAMI, FL
LONG BEACH	3FOU3	FRITZ MARITIME AGENCIES	SEATTLE, WA
MAERSK LIMA	OXOL2	MAERKS INC.	LOS ANGELES, CA
MAERSK SANTOS	J8IT6	MAERSK SHIPPING	BALTIMORE, MD
MAERSK TACOMA	C6MG2	MAERSK PACIFIC LIMITED	SEATTLE, WA
MARITIME FIDELITY	3EHE3	KERR NORTON MARINE	SEATTLE, WA

NAME OF SHIP	CALL	AGENT NAME	RECRUITING PMO
MERLION ACE	9VHJ	WILLIAMS, DIMOND & COMPANY	LOS ANGELES, CA
MICHELLE	XYLG	KERR NORTON MARINE	SEATTLE, WA
MOSEL ORE	ELRE5	T. PARKER HOST, INC.	NORFOLK, VA
MSC DANIELA	3FAX3	DECKERS & WIRTZ	MIAMI, FL
MSC MAUREEN	V2UY	MARCHALLINGER CO	MIAMI, FL
NEPTUNE JACINTH	9VHQ	INTERNATIONAL SHIPPING CO.	SEATTLE, WA
NOBLEZA	ELDF7	WIHELMSEN LINES (USA)	BALTIMORE, MD
OCEAN LAUREL	3FLX4	K LINE AMERICA, INC	SEATTLE, WA
OCEANBREEZE	ELLY4	DOLPHIN CRUISE LINE	MIAMI, FL
OLEANDER	PJJU	BERMUDA AGENCIES LTD.	NEWARK, NJ
PATRICIA	LAPL4	TORVALD KLAVENESS & C0 A/S	MIAMI, FL
PIONEER RUNNER	3EVD5	WILHELMSEN LINES (USA) INC.	NEWARK, NJ
POINT DORAN	NLXX	USCG POINT DORAN (WPB-82375)	SEATTLE, WA
POLAR EAGLE	ELPT3	NATIONAL WEATHER SERVICE	LOS ANGELES, CA
PRINCESS DIAN	ELJT9	WILLIAMS, DIAMOND CO.	SEATTLE, WA
REGAL PRINCESS	STGP	PRINCESS CRUISES	MIAMI, FL
RIO ENCO	CBRE	CHILEAN LINE INC. (GENERAL AGENCY)	NORFOLK, VA
RUBIN STELLA	3FAP5	INTERNATIONAL SHIPPING CO., INC	SEATTLE, WA
SAN DIEGO	P3CZ6	MARAN AGENCIES INC, NEWPORT FINANCIAL CTR	NEWARK, NJ
SANKO LAUREL	3EXQ3	CASCADE MARINE AGENCY LTD	SEATTLE, WA
SANKO POPPY	3EVE3	CASCADE MARINE AGENCIES	SEATTLE, WA
SANKO SPLENDOUR	3EZK3	EASTERN SHIPPING CO., LTD.	NEW ORLEANS, LA
SEA EXCELLENCE	VRUQ2	GENERAL MARINE AGENCIES, INC.	MIAMI, FL
SEA PREMIER	FNXB	HASLER AND CO.	NORFOLK, VA
SEABREEZE I	3FGV2	DOLPHIN CRUISE LINE	MIAMI, FL
SERENITY	ELLW5	TRANS-ATLANTIC AGENCIES, INC.	BALTIMORE, MD
SERENITY	YJYC6	MERIT STEAMSHIP AGENCY INC.	SEATTLE, WA
STAR PRINCESS	STAR	PRINCES CRUISES	MIAMI, FL
SVEN OLTMANN	V2JP	KING OCEAN/SUN TERMINALS INC	MIAMI, FL
TAMATIKI	MSYY9	CHLINE, PORT NEWARK OFFICE	NEWARK, NJ
TORBEN	V2TI	STEVENS SHIPPING AND TERMINAL CO.	NORFOLK, VA
TRIGGER	ELDU4	BARWIL OCEANIC AGENCY	SAN FRANCISCO, CA
USNS INDOMITABLE	NKVY	MILITARY SEALIFT COMMAND	NORFOLK, VA
USNS SUMNER	NZAU	USNS SUMNER T-AGS 61	NEW ORLEANS, LA
USS RUSSELL DDG-59	NEVV	USS RUSSELL DDG-59	NEW ORLEANS, LA
VALENCIA SENATOR	P3JK4	LAVINO SHIPPING (SOUTHERN STEAMSHIP AGENCY)	NEWARK, NJ
WADDELL SEA	HOYT	COSCO (HONG KONG) GROUP LTD.	NEW ORLEANS, LA
WESTWOOD FUJI	S6BR	NORTON LILLY INTERNATIONAL, WESTLAKE CTR OFF TWR	SEATTLE, WA
YURI OSTROVSKIY	UAGJ	FESCO AGENCIES N.A.	SEATTLE, WA
ZENITH	ELOU5	CELEBRITY CRUISES INC	MIAMI, FL
ZIM ISRAEL	4XGX	ZIM AMERICA SHIPPING CO.	MIAMI, FL
ZIM ITAJAI	C6LF2	ZIM AMERICA SHIPPING CO.	MIAMI, FL
ZIM ITALIA	4XGT	ZIM AMERICA SHIPPING CO.	MIAMI, FL
ZIM JAMAICA	SYKA	ZIM AMERICA SHIPPING CO.	MIAMI, FL
ZIM KOREA	4XGU	ZIM AMERICA SHIPPING CO.	MIAMI, FL
ZIM MEXICO	H2ST	ZIM AMERICA SHIPPING CO.	MIAMI, FL
ZIM NEW YORK	C6LC7	ZIM AMERICA SHIPPING CO.	MIAMI, FL
ZIM PARAGUAY	ELQW8	ZIM AMERICA SHIPPING CO	BALTIMORE, MD
ZIM PUSAN	SXZC	ZIM AMERICA SHIPPING CO.	MIAMI, FL
ZIM RIO	ELNX3	ZIM AMERICA SHIPPING CO.	MIAMI, FL

A Salute to Dick DeAngelis

Nancy O'Donnell
National Oceanographic Date Center

Over the last 8 years, Dick DeAngelis acted as chief meteorologist, editor, photographer, writer, paste-up artist, graphic designer, and distribution manager for the *Mariners Weather Log*. For most of those years, he produced each issue single-handedly.

Although Dick retired from NOAA in March, he returned as a consultant when he learned that the *Log* would cease publication after the summer issue. He said he wanted to be onboard when it went down.

His dedication to the *Log* is only one small part of a man, known for his generosity, good humor and modesty. When asked to provide some personal background information, Dick wrote many lines of praise of the people he'd met while editing the magazine.

Dick still has his New York City accent despite the number of years he's been away from his boyhood home in Northport, Long Island on Long Island Sound. It was here, he says, that he developed his love and respect for the water as he spent his childhood fishing, clamming and boating.

"My respect came from being in a hurricane in the Atlantic in 1958 and seeing my father's boat go down in another in 1960," says Dick.

Away from the water, Dick excelled in sports. His basketball skills (Junior College All-American) allowed him to continue beyond junior college. He went on to St. Louis University in Missouri and graduated with a meteorological degree.

He married his wife, Kirsten, and today 30 years later, he describes her as "my beautiful high school sweetheart."

Dick and Kirsten moved to the Washington, D.C. area, and in 1963, he started with the Weather Bureau. Four years later, he joined the Marine Branch. His daughter, Karen, and son, David, were born.

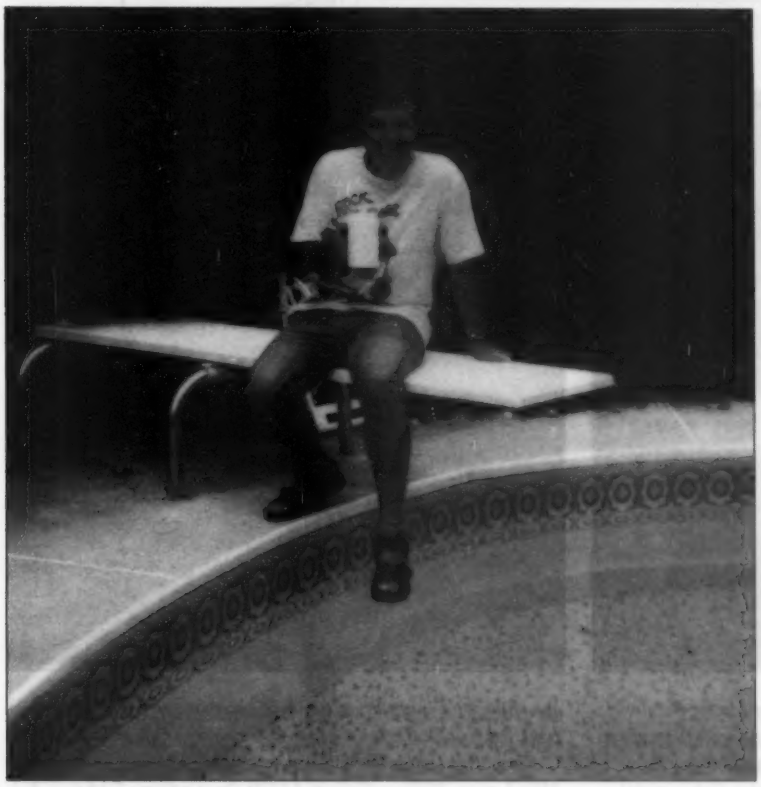
"I worked with the *Mariners Weather Log* right off the bat and learned the craft from George Cry and Pat Hughes. In those days, my duties included writing hurricane and typhoon summaries as well as the climatology for the Sailing Directions of U.S. Navy and the Coast Pilots of the National Ocean Service."

Dick also worked on a series of resort brochures with Sea Grant. "This was one of the most successful ventures that Sea Grant and the data centers were ever engaged in."

Dick was made editor of the *Log*, whether he wanted it or not, with the Summer 1986 issue.

"After Earl Wilson retired, I was asked to take over, but I declined. I could see the work involved and the shrinking staff. A short time later, I was told I *was* editor."

Dick's training was in meteorology, but he instinctively knew that a magazine is worth little if it's not read. He revamped and



Dick is bearing up well after the double blow of retirement and the end of his beloved Mariners Weather Log. *He feels most comforted near his backyard pool.*

revitalized the *Log* looking for articles that would not only benefit mariners but entertain them as well. He kept the essentials: storm tracks, marine weather review, radio and hurricane reports. But soon he added stories about haunted lighthouses and high seas rescues. He profiled National Marine Sanctuaries and Merchant Marine Academies. And mariners wrote in to thank him.

He converted the physical production of the journal from manual paste-up methods to computerized production on a Macintosh desktop publishing system.

As a photographer, Dick realized the importance of graphics to text and in recent years he added paintings and photographs from modern and classic artists to the *Log*. The cover of one issue was especially praised by readers when he used *The Flying Dutchman*, a haunting painting by the American artist Howard Pyle. The painting, which depicts the gaunt captain and crew of the cursed ship who are never allowed to put into port, was used to compliment a feature story on dangerous and very real derelict ships.

Dick worked to join the artistic with the scientific, and he planned to make each issue a little better than the one before.

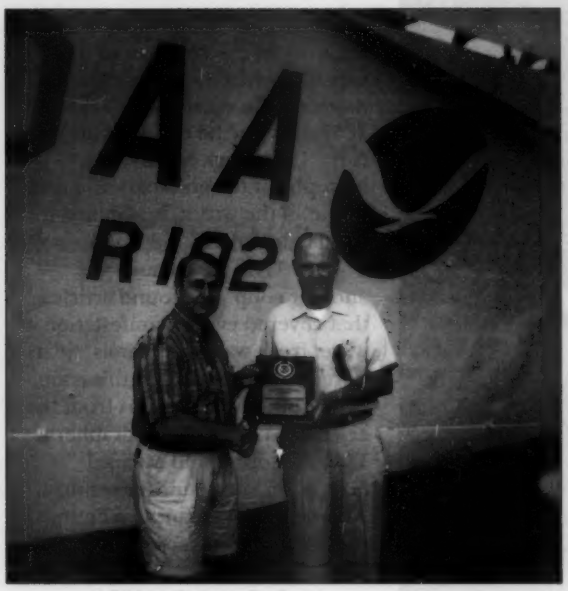
His sense of the practical, it must help mariners, combined with his sense of the aesthetic made many of his issues collector's items. He had his favorites. The Summer 1991 issue, which featured the story of the recovery of treasure lost when the S.S. *Central America* sank during a hurricane in 1857, was one he crafted with great care. Once Dick saw the photographs of the gold bars and coins found in the wreck, he lobbied for a full color cover, and won it.

"The wave issue" was another coup. He found articles that covered every manifestation of wave: freak waves, tsunamis, tidal bores and solitans. For this issue, he collected wave photos from the celebrated ocean photographers, Warren Bolster and Michael Halminski and found 19 century American and Japanese paintings of ships scudding across violent seas to illustrate the text.

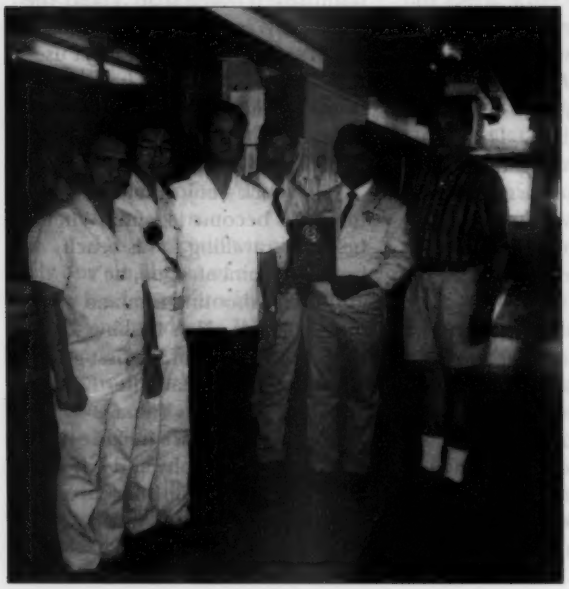
In September 1994, Richard Abram, Branch Chief of the National Oceanographic Data Center, nominated Dick for the NOAA Administrator's Bronze Medal Award for "outstanding service to NOAA--and the worldwide maritime community--as the Editor of the *Mariners Weather Log*." The nomination noted that "Today the *Mariners Weather Log* is recognized worldwide as one of the most useful sources of data and information related to marine meteorology and as one of NOAA's premier publications."

Dick's enjoyment of retirement has become legend. When he's not travelling to his beach home in Chincoteague, he's antiquing, shooting film and going to the movies. He's looking forward to the birth of his first grandchild courtesy of daughter Karen and husband, John Talnagi.

"My hobbies include ice hockey, photography and girl watching. Now that I'm retired, two out of three ain't bad."

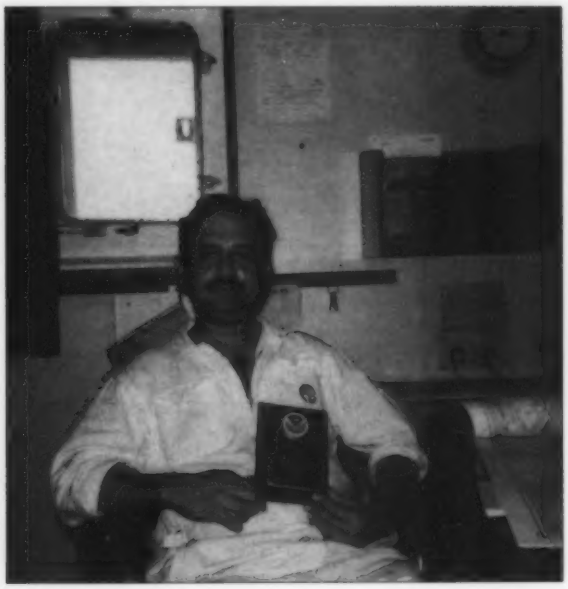


Above, NOAA Ship Discoverer's *Chief Quarter Master Bernard J. Greene receives one of the top honors for 1993 in the VOS awards program from Pat Brandow, PMO Seattle (on left). Below Pat Brandow awards the crew of* Golden Gate Bridge *(left to right) Radio Officer Ruel M. Alfafara, Chief Officer S. Sugiyama, Captain S. Matsuda, 2nd Officer Bonifacio C. Bretana, and 3rd Mate Roger B. Bolong. Above right, NOAA ship* Miller Freeman *took one of the top honors for outstanding observations for 1994. Left to right, 1st row: Lt. Daniel Cheng, Commanding Officer CDR John C. Clary, Ens Dawn Marei Welcher, Nicole Le Veque; 2nd row: Lt. Mike Lemon, William Talbert, LCDR Dennis Seem, Ed Long; 3rd row: Lt. Michael Francisco and Ens Todd Bridgeman. Below right: Seattle PMO Pat Brandow presents a VOS plaque to Jerzy Bialek, the Master of the vessel* Nordmax.



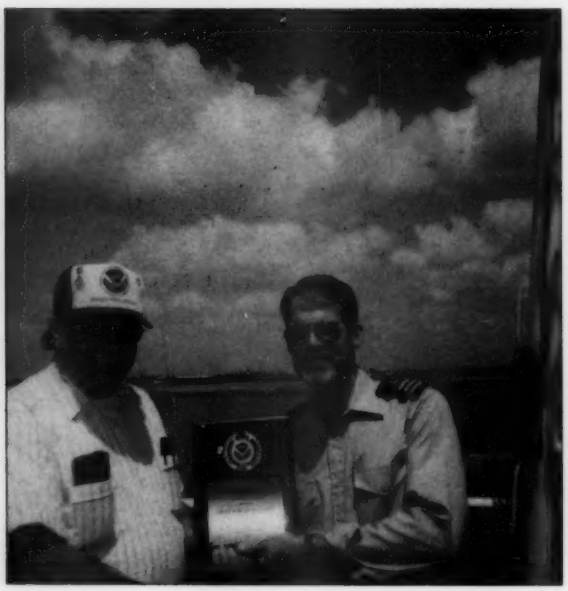
Seattle PMO Pat Brandow presents a VOS observation award to the crew of the Prince of Tokyo. *Standing left to right are Chief Mate Roldan Buranday, Captain Edmundo Erispe, Brandow, and Second Mte Roberto Licaylicay. A 1993 VOS Plaque was awarded to the* Virginia *for the high quality of surface weather observations. Pictured below (left to right) are PMO Brandow of Seattle, Captain Cho Hoi Chuen and Second Mate Jorge Solano.*

The real Newark PMO, John Bollinger, is pictured above. He was misidentified as a NOAA Program Manager in Alaska in the Spring issue of the Log. New Jersey is nothing like Alaska. Chief Mate Vivek Mehendale of the Federal Fuji *holds the VOS plaque he received from PMO Bollinger for outstanding weather observations.*



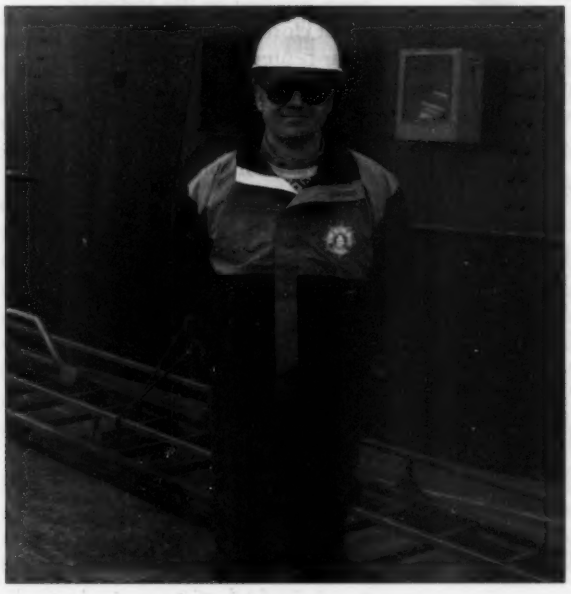
Captain Jim Bennett of the Columbia Bay *showing the 1994 award for excellence. Columbia Bay is one of four tugs providing weather routinely in the Gulf of Mexico and coastal Atlantic Ocean south of Charleston. In the infrequent position of hiding behind the camera is Jim Nelson, PMO Houston. Jim Nelson congratulates Chief Officer Robert N. Ethier of The* Sea-Land Integrity *for excellence in weather observation in 1994 in the photo below.*

*Don Oettinger, Data Acquisitions Program Manager, Houston, presents a second award to Chief Officer Robert N. Ethier (*Sea-Land Integrity*), for being one of the top ten ships in transmitting weather observations via SEAS in 1994. The* Integrity *ended up with 1211 observations for the year. Below right Captain Jacques Chevarie of the m/v* Lucy Maud Montgomery *displays his vessel's 1994 award for outstanding contributions to the VOS Program presented by PMO Randy Sheppard of Environment Canada.*



Above, m/v Lucy Maud Montgomery *crew wear jackets awarded to top observers 2nd mate Huntly Taker and 1st Mate Paul Arsenault (left to right). Vessel and crew have been consistent performers for many years. Below, Andrew Kleiser, an officer on the m/v Algoriver, sports his VOS observer jacket. Andrew, one of the top 22 observers in 1994, is a participant in the Canadian Great Lakes program. PMO Keith Clifford presented the award.*

Above, Nelson Abarrientos, an officer on the m/v Algogulf, *won a jacket as a VOS observer in 1994. He is seen here aboard his vessel in Hamilton, Ontario. Photograph by Environment Canada PMO Keith Clifford. Below, Norman McKay (left), an officer on the ss* Mapleglen, *congratulates Captain Richard Samson on the Gold Seal won by the vessel in 1994. Photo was taken by Keith Clifford.*



All times unless noted are UTC (universal time) and all miles are nautical. For additional detail, tropical cyclones will be covered in the annual reports from the tropical cyclone centers around the world and in Hurricane Alley. The weather summaries are based upon the track charts and Northern Hemisphere Surface Charts as well as ship reports and attempt to highlight the most significant ocean features each month. The track charts are provided by NOAA's National Meteorological Center. If an extratropical storm is particularly bad for shipping, we may designate it as the Monster of the Month.

–ed.

North Atlantic Weather
January, February and March 1995

January– Both the Azores–Bermuda High and the Icelandic Low were more intense than normal on the Northern Hemisphere mean pressure charts this month. Thus a strong gradient was established from the Grand Banks to the North Sea and this spelled trouble for mariners traversing the northern shipping lanes. This was reflected at the 500–millibar level as well.

A 956–millibar Low southeast of Kap Farvel at 1200 on the 6th had its origins over Maine a couple of days earlier. This storm dominated weather across the northern shipping lanes and in the northern fishing areas over the next few days as it traversed the Denmark St. While there were not too many ship reports, the coast of Iceland was battered by 40–knot winds at 1200 on the 7th as the storm began to weaken and split into two centers. Out ahead of its cold front in the Norwegian Sea, rigs were reporting 40–knot southwesterlies. The LDWR (56°N, 01°E) ran into 45–knot southerlies in 8–meter seas. By 0000 on the 8th, the storm reorganized into a 961–millibar center northeast of Iceland and its circulation still had a stranglehold on the shipping lanes. It remained potent as it moved toward the Barents Sea on the 9th.

Monster of the Month– A storm developed over Nova Scotia on the 13th and headed northeastward toward an existing circulation which had covered the Greenland Sea and Denmark St. for several days. This Nova Scotia system was no great shakes until the 15th when it began to intensify rapidly. It exploded on the 16th when its pressure plummeted to 948 millibars over Iceland. At this time it was a small compact circulation raising havoc for those sailing the Denmark St. On the 17th at 0000, a secondary 968–millibar center developed near 50°N, 20°W. Twelve hours later it was raging at 948 millibars and swinging northeastward close to Ireland. It had become the dominant system. The ZCAW6 (48.5°N, 16.0°W) reported 45–knot winds in 5–meter seas as this storm and its associated front terrorized vessels from the Irish Sea to the Bay of Biscay. By 0000 on the 18th, it reached a peak of 940 millibars as its center brushed the Outer Hebrides on a recurving path. At 1200 the ***Cumulus*** near 52°N, 20°W hit 40–knot winds in 7–meter swells. Winds of 55 knots were howling on the Icelandic coast close to the storm's 944–millibar center. Finally on the 20th things began to calm down somewhat, although the P3LX5, some 600 miles south of the center, ran into 45–knot winds in 14–meter seas.

The circulation remained intact for several more days and within it a potent system developed over Scotland on the 22nd. By 1200 a 960–millibar center was analyzed over the North Sea with a circulation that covered a good portion of the eastern North Atlantic, North, Norwegian and Greenland Seas as well as the Bay of Biscay. While this storm was not overwhelming it did control ocean weather until the 24th.

On the 25th a western North Atlantic storm, which had formed over Sonora, Mexico just 4 days earlier, intensified into a 962-millibar blow over the Grand Banks. It did generate some gales and strong gales on the 25th and 26th as it made its way northward. At 1800 on the 26th, the OYSN about 300 miles south of the 962-millibar center reported a 40-knot westerly in 4-meter swells while another vessel (CFO36) closer to the center hit 45-knot winds in 5-meter seas. By the 27th the storm was weakening south of Kap Farvel.

Toward the end of the month a potent storm came to life near 55°N, 35°W. At 0000 on the 30th its center was estimated at 966 millibars. By 1200 it was down to 955 millibars and moving east northeastward. Gales and strong gales were being reported close to the center and to the southeast where the pressure gradient was being enhanced by a large 1031-millibar High. By the 31st the frontal system and tight pressure gradient were creating problems from southwest of the English Channel through the North and Norwegian Seas.

Casualties— The U.S. Army Reserve tug ***Salerno*** was steaming from Baltimore to Wilmington, NC when a crack was discovered in the engine casing off Cape Hatteras, where winds were 30 to 40 knots with 6-meter seas. The Navy cruiser ***Normandy*** came to the tug's aid and towed it in.

In the North Sea at the beginning of the month, the safety/supply vessel ***Seaboard Swan*** with 12 people aboard had her bridge windows stoved in and lost power and steering in rough seas and force 8 to 10 winds. They did regain power. Meanwhile the ***Linto*** capsized but all crew were rescued and the ***Forthbank*** reported problems with shifting deck cargo in high winds and heavy seas on the 1st near 54.2°N, 3.4°E. The crane barge MB101 with seven crewmen was driven aground near Sea Palling. The crew was taken off.

The ***Heldo,*** Flushing for Fredriksted, sustained damage off Esbjerg in heavy seas on the 10th. The foremast was bent, the lifeboat torn off the anchoring and three ventilator lids went overboard.

February— Similar to the previous month both of the major features on the Northern Hemisphere mean surface chart, the Icelandic Low and the Azores-Bermuda High were stronger than normal. In fact the Icelandic Low had a center both near Iceland and off the northern coast of Norway. The intense pressure gradient remained in place over the northern shipping lanes, and at the 500-millibar steering level, storms were guided in a general east northeastward pattern, from Newfoundland to Scotland, for example.

Monster of the Month—This storm had its roots in January but became one of the most potent storms of the year in February. It came to life on the 29th of January over southern Georgia. Moving offshore it intensified slowly as the month came to an end. By the 31st it was a 982-millibar Low near 38°N, 62°W. The KRHX about 200 miles south of the center was reporting 40-knot winds in 5-meter swells. A vessel close to the center reported a 985-millibar pressure. However, just 12 hours later the northeastward moving system was analyzed at 957-millibars—a drop of 28 millibars—explosive to say the least. The C6IL3, about 200 miles southeast of the center, was blasted by 50-knot winds as was the VRIV which was battling 9-meter swells. But this was not the end of the intensification. By 1200 on the 1st, central pressure was at 930 millibars and by 0000 on the 2nd it was down to 926 millibars, a 31 millibar drop in 24 hours. At this later time the TFLE some 300 miles to the southeast was blasted by 50-knot west northwesterlies. The storm center dropped to 924 millibars by 1200 on the 2nd as it crossed the 55th parallel near 37°W. Swells of 5 to 6 meters and gale force winds were common to the south and east out to about 600 miles from the center. This severe storm continued into the 3rd as it closed in on Iceland, but later in the day it began to weaken as it moved into the Denmark St.. However it was still generating gales over the northern shipping lanes and in the Norwegian Sea.

On the heels of the previous storm, a short-lived but potent Low developed over the Delmarva Peninsula on the 4th. By 1200 on the 5th in the Gulf of Maine its central pressure was at 962 millibars. Along the cold front which bulged to the southeast and back to the southwest, vessels were encountering gales and 5- to 8-meter swells. The LAV44 (34°N, 73°W) ran into 40-knot west southwesterlies in 5.5-meter swells. While this intensity remained into the 3rd, the

963-millibar center was recurving over Labrador. By the 7th it was a weak broad system.

On the 7th, a 945-millibar Low intensified over the Barents Sea. Its circulation extended over the Norwegian and North Seas as well as the Baltic. Gales were being generated and several smaller centers developed within the circulation. It remained potent with little movement through the 10th.

On the 8th a Low came to life east of the New Jersey coast and headed northeastward. On the 9th its central pressure had dipped to 980 millibars and 24 hours later had plummeted to 948 millibars as the center crossed the 55th parallel near 40°W. Kap Farvel was registering 60-knot winds although there were only a few gale reports from vessels in the circulation at 0000. At 1200 on the 10th the SKDZ some 500 miles south of the 948-millibar center reported 40-knot winds in 7-meter seas. Once again the real action was along the storm's cold front where 4- to 5-meter swells and gales were common. The storm remained potent but on the 13th another center intensified and took over off Newfoundland. This 956-millibar center was responsible for gales and strong gales in 3- to 6-meter swells in the Grand Banks waters. These same conditions were also being encountered in mid ocean within the large circulation and in the area between the warm and cold front. Vessels being affected included the Y5EQ, WQVY and the ELML. This Newfoundland center became the dominant one as it headed northeastward on the 14th. However, by 1200 on the 15th there were two centers and the circulation covered the entire eastern North Atlantic. The ***Cumulus***, south of the Newfoundland center reported 40-knot southwest winds in 4.5-meter swells. The following day one 965-millibar center was located over the Norwegian Sea. It began to weaken on the 17th.

This storm developed south of Hudson Bay on the 15th. It swung through the Gulf of St. Lawrence and across northern Newfoundland before moving onto the Atlantic on the 16th. However it took another day to really intensify. From 974 millibars at 1200 on the 17th its pressure dipped to 960 millibars 24 hours later. By 0000 on the 19th it was down to 953 millibars just south of Iceland. The ***Cumulus*** came in with a 40-knot west southwesterly in 5-meter seas and this was more or less typical of conditions along the shipping lanes in and out of the Channel. The system weakened slowly over the next few days.

On the 22nd a 1010-millibar Low was analyzed over Minnesota. It crossed southern Lake Michigan heading southeastward. But the following day it turned northeastward across Lake Erie and moved up the St. Lawrence River on the 24th as pressure dipped below 1000 millibars. It entered the North Atlantic off Labrador on the 25th and continued to intensify. By 1200 on the 26th, the eastward moving 982-millibar Low clipped Kap Farvel. The following day it turned toward the northeast and central pressure dipped to 964 millibars. The storm was generating gales along the 60th parallel from Kap Farvel eastward. Another center was analyzed to the east of Iceland and a good fetch developed between southern Greenland and the coast of Norway as the month came to a close.

Casualties— Three Danish fishermen were presumed dead after their wooden vessel ***Leif Brink*** disappeared in a North Sea storm at the end of January. On the 6th the Dutch waterways, a large trade artery for northwestern Europe, reopened to shipping as the Netherlands recovered from some of the century's worst flooding. Shipping had been banned since January 29th to protect the country's fragile dikes and water defenses. The wooden fv ***Loo Maze*** drifted and ran aground on rocks near the fishing harbor of Le Conquet after an engine breakdown in bad weather. The crew was safe. The container vessel ***Mor*** sustained heavy weather damage near 46.5°N, 27.3°W on the 16th.

March—The month opened with a huge double-centered Low covering most of the northeastern North Atlantic. At 0000 on the 1st the ***Cumulus*** (53°N, 18°W) was encountering 30-knot west southwesterlies in 3.5-meter swells while farther to the south the VRUK2 was belted by 35-knot northwesterlies in 4-meter swells. Close to the 960-millibar center off the coast of northern Norway, the LDWR4 reported 40-knot westerlies. The 978-millibar was located at the southern entrance to the Denmark St. This storm persisted for several days and its circulation was enhanced by a huge 1038-mil-

libar High to the south which stretched from the East Coast of the U.S. to Africa.

On the 7th a Low developed near 45°N, 50°W. Moving northeastward it intensified. By 1200 on the 18th, its 968-millibar center now moving along the 50th parallel crossed 30°W. This compact system was generating storm force winds as testified to by several vessels including the C6IZ4 which encountered 60-knot winds near 45°N, 30°W. The EIVL7 out ahead of the cold front hit 40-knot southwesterlies in 7-meter swells. By 0000 on the 9th, the central pressure had dipped to 965 millibars as the storm continued eastward. At 1200 a vessel 150 miles to the south of the center reported a 35-knot southwesterly and another farther south hit 30-knot winds in 5-meter swells. The LAZA2 (47°, 33°W) ran into 35-knot northwesterlies in 4.5-meter swells. The storm began to weaken on the 10th and as it approached the 15th meridian it swung northward, passing between Iceland and Scotland on the 11th. Once into the Greenland Sea it began to reintensify. By 1200 on the 12th, pressure had dipped to 960 millibars and fell to 958 millibars the following day over Svalbard.

In addition another system from the Gulf of Maine moved into the southern part of this circulation to dominate the northern shipping lanes through the 14th.

On the 15th a center developed over the Denmark St. in the southern part of the previous circulation. Moving east southeastward it intensified to 963 millibars over the Norwegian Sea by the 18th. Its circulation was influential south to the Bay of Biscay and at 0000 on the 18th the ***Cumulus*** reported 30-knot winds in 3-meter swells. The Low swung northward but continued to influence weather over the North Sea and in the English Channel through the 19th.

Meanwhile an inconspicuous low pressure center was coming to life on the 18th off Long Island, New York. Heading northeastward it organized over the Grand Banks the following day and by 1200 on the 20th was sporting a 972-millibar center near 50°, 45°W. The following day its central pressure was down to 966 millibars as the storm approached the Denmark St. The SPKT (50°N, 35°W) ran into a 40-knot southwesterly in 10-meter seas in a trough which extended southward from the center. The Low stalled in the Denmark St. and weakened by the 24th.

Several weak to moderate Lows moved across the North Atlantic during the final week of March and one intensified to 961 millibars by 0000 on the 31st. This system developed near 37°N, 50°W on the 28th. Moving north northeastward it slowly intensified until 1200 on the 29th. From that point to 1200 on the 30th, its central pressure dropped 22 millibars in 24 hours, just short of explosive deepening. By the 31st gales were common in the seas around Iceland. As the month came to a close, two centers were analyzed and the circulation stretched from the Denmark St. to the Norwegian Sea.

Casualties– The msc ***Lucy*** lost 20 containers in the Bay of Biscay on the 8th. The ***Pelhunter*** sank in stormy weather about 140 miles southeast of Catania, Italy on the 13th. Three of its crew were rescued with five dead and seven missing. The ***Westwind*** grounded in bad weather at Lagskar, Aland Islands on the 17th resulting in severe bottom damage. On the 14th the mv ***Kreva*** grounded in bad weather outside Husum harbor in the Gulf of Bothnia. Off Portugal on the 15th the trimaran ***Muddy Waters*** encountered strong winds and high seas and overturned and sank killing one of two crew members.

Fifty fishermen were missing and two people killed as high winds whipped up the Caspian Sea flooding coastal areas of the Kalmyk republic in southern Russia on the 15th.

North Pacific Weather
January, February and March 1995

January– The major feature on the Northern Hemisphere mean pressure chart for January in the North Pacific was the dominating Aleutian Low. Not only did it cover a good portion of the ocean but resulted in anomalies of as much as –14 millibars. In the upper levels, this was apparent as a deep trough at 500 millibars extended from the Alaska Peninsula southeastward to near the California coast.

Monster of the Month– The month opened with a blockbuster leftover from December like a New Year's Eve hangover. A 966–millibar Low was spotted near 37°N, 165°E at 0000 on the 1st. The WPGK about 250 miles south of the center ran into 50–knot southwesterlies in 6–meter swells. Several other vessels were battling gales and strong gales and the DEDD hit a 60–knot blow. All this before the system reached its peak. Some 12 hours later central pressure dipped to 952 millibars. The WPGK was still battling storm force winds while the DEDD fought 9–meter swells and the VRCY, just west of the center, was blasted by 50–knot north northeasterlies. Several ships were reporting snow which was causing visibility problems along with the gale to storm force winds. At 1200 on the 2nd, the WPGK and 3FGH3 about 600 miles south of the center were still caught in storm force winds and 6–meter swells. The DXIT2 nearly in the center of the storm reported a 955.8–millibar pressure in 10–meter seas and 45–knot winds. By 1200 on the 2nd the central pressure was estimated at 950 millibars as the storm crossed the dateline near 46°N. Ships were now avoiding this storm like the plague. The storm continued east northeastward and began to fill. However, it remained potent until the 5th. Strong gale to storm force winds continued to be encountered on the 4th out to 900 miles south of the center. The circulation to the southwest was being enhanced by a 1028–millibar High over the south central North Pacific.

While several moderate to strong Lows made their way across the Pacific during the next week their effects were short–lived. Then on the 14th another potent storm showed up near 45°N, 175°E.

This system which began on the 12th, really blossomed on the 14th. Central pressure dipped from 974 millibars at 0000 to 957 millibars by 1200– a drop of 17 millibars in 12 hours. The ZEDE near 40°N,

170°E at 1200 ran into a 55-knot westerly. The 3EUUG about 300 miles southeast of the 956-millibar center at 0000 on the 15th battled storm force winds in 12-meter seas. The storm continued to plague shipping as it moved across the Aleutians and made a U-turn near 55°N on the 16th.

At this time a secondary center moved in from the southwest and took control of the system. By 1200 it was at 952 millibars and crossing the Alaska Peninsula. The huge circulation covered a good portion of the northern shipping lanes and was generating gales south of 45°N on the 17th. Several other centers had formed within this circulation. One intensified into a 968-millibar center on the 18th and moved into the Gulf of Alaska. It wasn't until the 20th that the whole system finally began to weaken.

The next big storm came to life on the 23rd east of Tokyo. It travelled east southeastward then began to recurve on the 24th as it crossed the dateline. During this period it intensified slowly and caused little problem to shipping. On the 26th the storm began to get a life. Its central pressure dropped to 962 millibars by 1200 and the KHRK right near the center ran into 45-knot westerlies. At 0000 on the 27th its 957-millibar center was heading northward into the Gulf of Alaska. The KGJX battled 10-meter swells to the southeast of the center while the ULE57, caught in between this storm and a 1050-millibar High north of Kamchatka, battled 6-meter seas. The Low was dominating weather over the northeastern North Pacific and the Bering Sea during the last few days of the month. As the month came to a close another center to the south tool control of the circulation and developed into a 966-millibar system on the 30th. January came and went with a bang in the North Pacific.

Casualties– The Gladiator from Vancouver for Los Angeles experienced bad weather resulting in damaged and shifted containers, arrived San francisco Bay on the 9th to assess damage. The tug ***Neptune***, with barge under tow, experienced heavy weather on the 8th near Crescent City, California and was not able to control its tow. Both were deliberately ground with no apparent damage. A Philippine-registered small tanker ***M.T. Mahal*** sank in rough seas in the central Philippines, killing the captain and chief engineer on the 14th, about 200 miles south of Manila. The vessel was hit by three successive big waves on its bow and capsized and sank within 3 minutes. The 10 survivors were able to get on liferafts.

February– Like January the Aleutian Low was in control on the Northern Hemisphere mean surface pressure chart, except that it was much closer to normal. At 500 millibars the mean chart showed mostly zonal flow west of the dateline with a trough and a ridge over the eastern North Pacific.

An extremely complex circulation, consisting of numerous moderate low centers, dominated the first week of February over the eastern North Pacific. On the 5th it briefly organized into a single 958-millibar center off the Alaska Peninsula and created a tight pressure gradient over the eastern Gulf of Alaska. Just east of this center the J8UG battled 5-meter swells at 1200.

On the 4th a Low developed south of Tokyo. It intensified quickly and by 1200 on the 6th its pressure had dipped to 960 millibars as is headed east northeastward. By 0000 on the 7th central pressure reached 950 millibars and the 3EKV5 ,about 150 miles south of the center, ran into 55-knot winds in 12-meter seas. Gales were being reported out to 600 miles east and south of the center. By 1200 the 945-millibar center had crossed the 45th parallel near 175°E. At 0000 on the 8th the JLMY (39.2°N, 178.2°E) was clobbered by 55-knot winds in 6-meter swells. As the system neared the Aleutians it began to weaken and recurve into the Bering Sea.

On the heels of the previous storm came another Tokyo Low which developed on the 9th and headed toward the east northeast. By 1200 on the 10th, its central pressure dropped to 985 millibars and about this time it began to recurve near 170°E. However, it continued to strengthen and by 1200 on the 11th a 962-millibar center crossed the 45th parallel. To the south of the center swells were running 4 to 6 meters as reported by such vessels as the C6GR, 8JGU and the 3ERJ8. The C6GR also encountered a 50-knot west northwesterly at 0000 on the 11th. The system began to weaken as it continued to recurve toward the northwest and crossed the Kamchatka Peninsula on the 13th.

This system developed on the 18th near 40°N, 170°W and headed toward the Gulf of Alaska. From 992-millibars the central pressure fell to 986 millibars by 1200 on the 19th and to 964 millibars some 24 hours later as it approached Prince William Sound. By 0000 on the 20th, near gale and gale force winds were being reported throughout the near North Pacific. The ELJP6 near 38°N, 147°W encountered a 45-knot northwesterly in 5-meter swells. By 0000 on the 21st, the 960-millibar center was moving inland near Valdez. To the south, winds in the 35- to 40-knot range with 4- to 5-meter swells were common. By 1200 the storm had significantly weakened.

A series of weak to moderate Lows dominated the North Pacific until month's end.

Casualties– On the 5th the mv ***Sun River II*** with a crew of 35 sank off southern Japan in choppy seas and strong winds. Twenty-one crew members were rescued but eleven died and three were listed as missing.

March– The month began with the remnants of a February storm– a 970-millibar Low centered near 42°N, 175°W generating gales and strong gale winds. At 0000 on the 1st, a vessel some 200 miles southwest of the center encountered 40-knot winds in 4-meter seas and this was fairly typical of conditions within 200 miles of the storm center. At 1200 the C6LF9 hit a 40-knot westerly in 4.5-meter swells. The system recurved northward on the 2nd and began to slowly weaken.

Monster of the Month– On the 3rd an atmospheric wave developed along a stationary front over the Ryukyu Islands. Moving east northeastward it organized into a separate circulation with a 987-millibar center by 0000 on the 4th. At this time the C6JD4 reported a 40-knot west southwesterly near 27°N, 141°E. From 1200 on the 4th to 1200 on the 5th, the central pressure dropped from 976 millibars to 956 millibars and this system became a major storm. At 0000 on the 5th, the ELKA7 (39°N, 153°E) was rocked by a 50-knot northerly in 7-meter seas. To the south vessels such as the JHQN, OWDQ2 and the ELEG9 were encountering gales and strong gales in 4- to 6-meter swells. The WNDP, about 120 miles north northeast of the 967-millibar center battled 60-knot east northeasterlies in 8-meter seas.

The storm remained potent as it began to turn a large counterclockwise loop from the 6th through the 10th between 40° and 45°N from 155°E to 170°E. This resulted in a prolonged period of poor weather over the northwestern North Pacific shipping lanes. At 1200 on the 7th, the DVDM, some 600 miles southwest of the 964-millibar center, was racked by 50-knot northwesterlies in 5.5-meter seas while the WNRD to the east of the previous vessel reported 40-knot westerlies in 6.5-meter swells. On the 8th swells south of the center, where a long fetch had set up, were running 6 to 9 meters. By the 9th the storm began to fill and weaken. It completed the loop on the 10th and was absorbed by another system.

During the time the previous storm was turning its loop, a major system was taking shape in the eastern North Pacific. At 1200 on the 7th, a 995-millibar center was located near 35°N, 154°W. The Low moved east northeastward then recurved toward the north. By 1200 on the 8th, its central pressure was down to 977 millibars but it wasn't alone. There were at least two other centers within the growing circulation. By 0000 on the 9th, the C6JR (34°N, 154°W) reported a 45-knot westerly in 8-meter seas and a nearby ship confirmed this with a report of 40-knot winds in 7-meter seas. The circulation now covered most of the northeast North Pacific including the Gulf of Alaska. At 1200 on the 9th, 968-, 969- and 972- millibar centers were analyzed. The DNKL (33°N, 140°W) hit 35-knot winds in 5-meter swells, and this was typical of conditions in the southern semicircle of the circulation. By 0000 on the 10th, gales were being encountered in a trough which extended to the south. By the 11th some weakening was evident as the centers began to merge and edge toward the southeast coast Alaska. The following day it was no longer a significant weather factor.

An eastward moving system formed off Honshu and briefly flared up in the mid Pacific along the 40th parallel on the 14th and 15th. At 1200 on the 14th, the central pressure dropped to 978 millibars and continued to fall reaching 969 millibars by 1200 on the 15th. However, some 24 hours later it had filled to 986 millibars and was weakening rapidly. At 0000 on the 15th, the 3EPF3 near the center hit a 40-knot westerly some 600 miles to the southwest.

On the 18th a 1000-millibar Low was analyzed near 30°N, 170°W. Except for its southerly latitude, there was nothing particularly impressive about this system. It accelerated northeastward the following day, but it wasn't until the 20th that this storm really came to life as it approached the Oregon-Washington coast. At 0000 the central pressure was at 976 millibars and 12 hours later was down to 962 millibars– explosive deepening. At 0000 the ELNV8, some 200 miles northwest of the center, hit 40-knot winds in 4-meter seas. At 1200 the ELPX9 was battling 50-knot northerlies and 7.5-meter swells in the same area. This was a compact storm, but within 200 miles of its center conditions were rough. The center edged inland across Vancouver Island on the 21st, and the system began to weaken slowly. However, thanks to a 1040-millibar High to the east a strong pressure gradient was maintained into the 23rd. This was testified to on the 22nd by the ELDG8 (50°N, 145°W) which ran into 50-knot northwesterlies in 8-meter swells.

Several weak to moderate Lows haunted the shipping lanes during the last week but in general March went out like a lamb in the North Pacific.

Casualties– In early March the twin-screw tug ***Seaspan Commodore*** brought in the Greek-owned bulker mv ***Wave*** after the ship had broken its propeller shaft in heavy weather. En route from the Orient to Vancouver, British Columbia, the 200-meter vessel broke its tail shaft on the 2nd in stormy seas 300 miles south of Kodiak Island.

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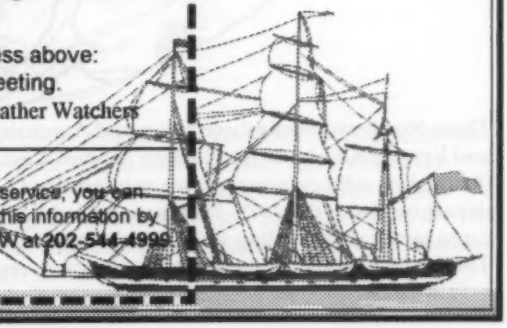

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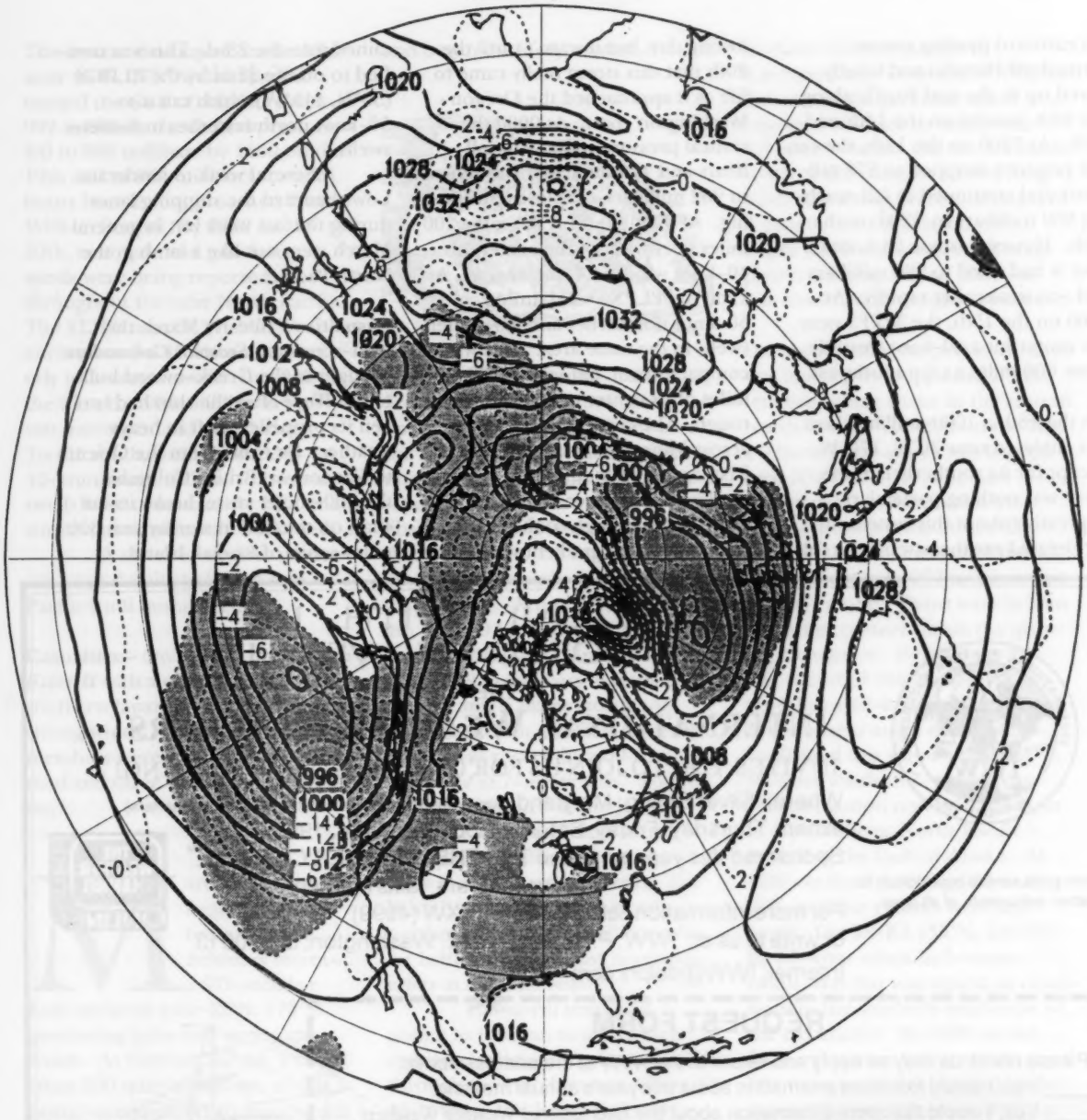
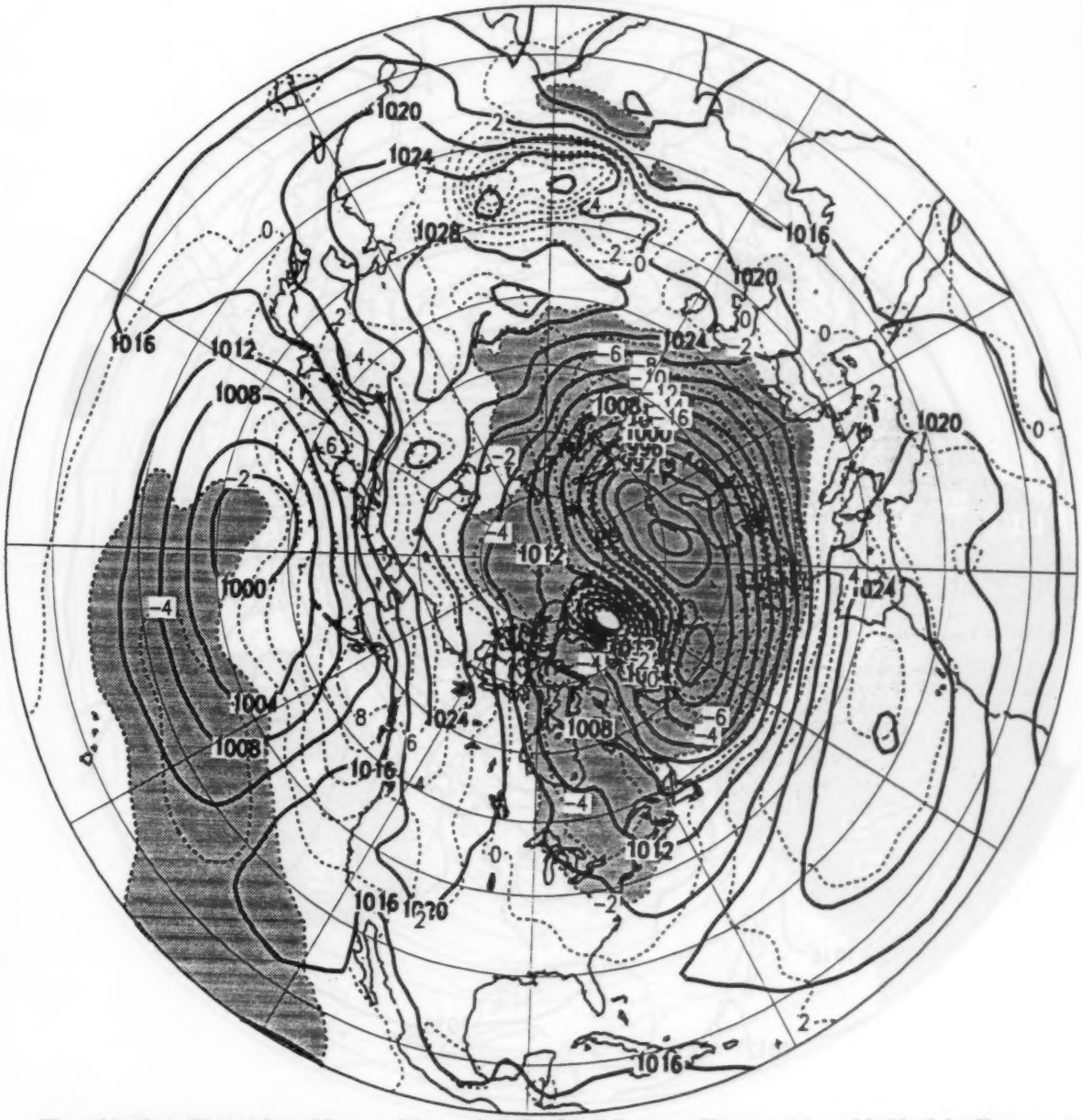


These Northern Hemisphere Mean and Anomalous Sea Level Pressure Charts were provided by John Kopman and Vernon Kousky of the Climate Analysis Center from the Climate Diagnostics Bulletin. Mean values are denoted by solid contours drawn at intervals of 4 millibars. Anomalies (contour intervals of 2 millibars) are departures from the 1979–1988 base period monthly means. Negative anomalies of less than 2 millibars are indicated by the dark shading while positive anomalies of greater than 2 millibars are indicated by the light shading. The analysis should be treated with caution in regions of elevated terrain.

February 1995



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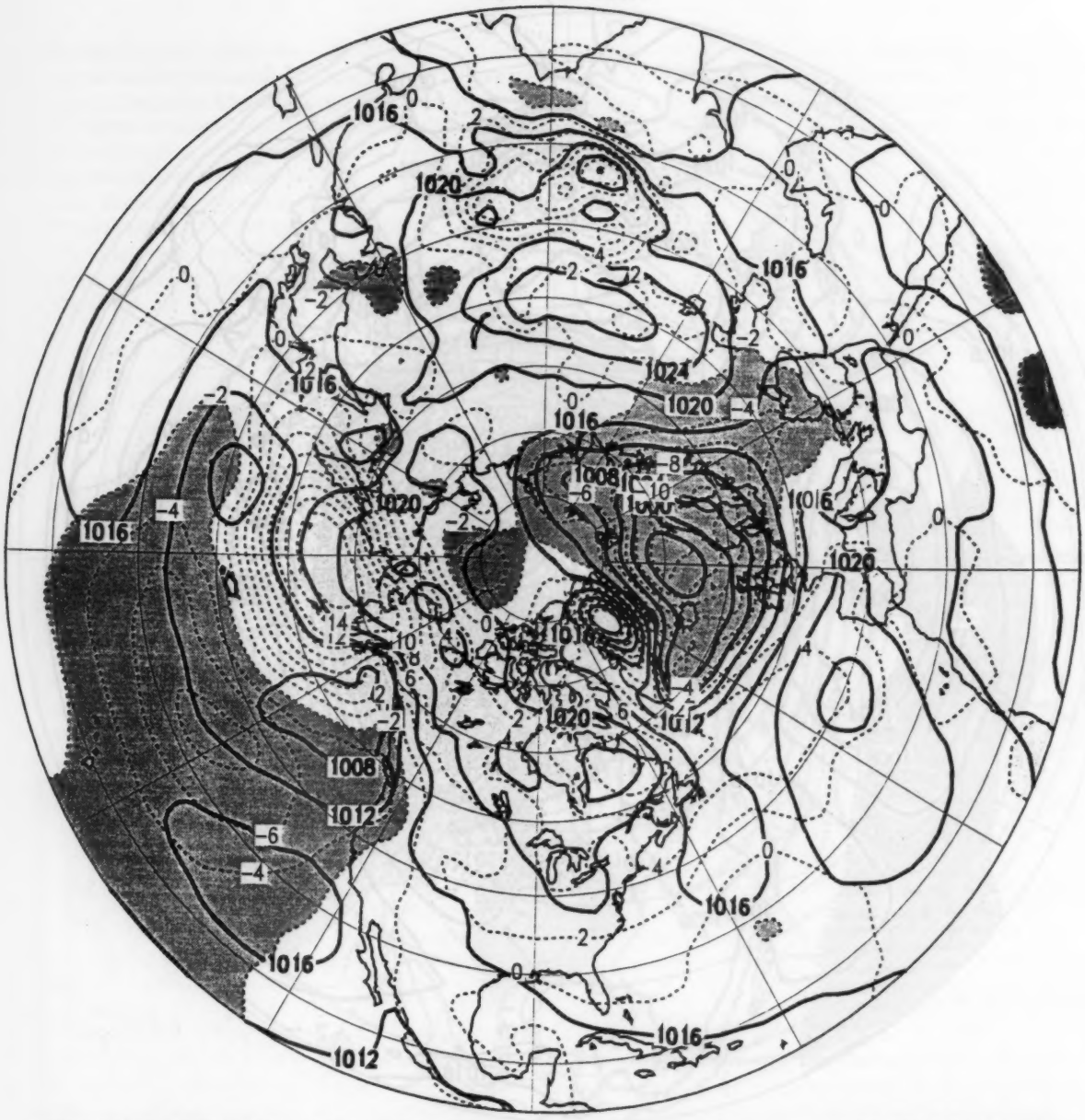
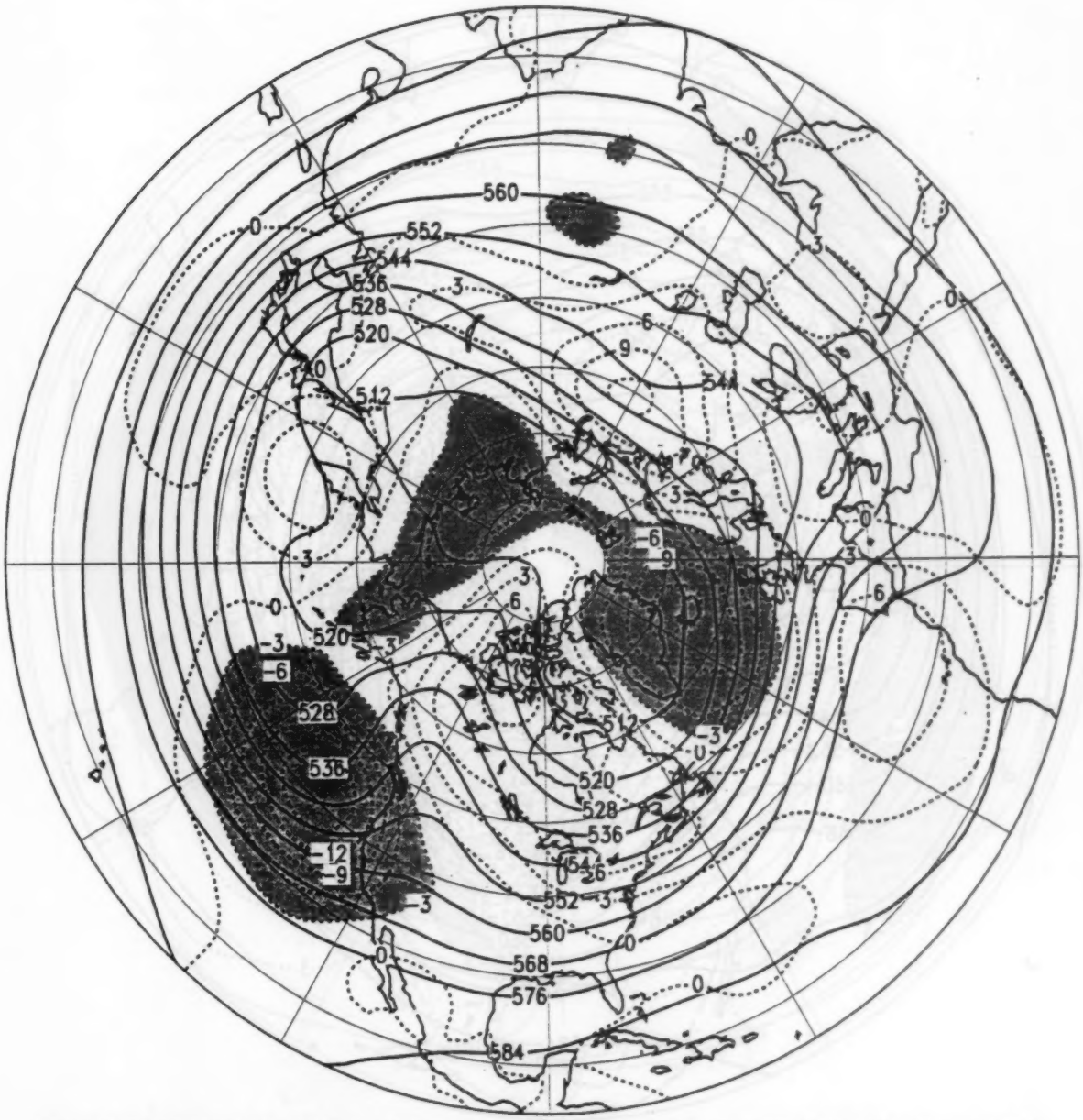
March 1995



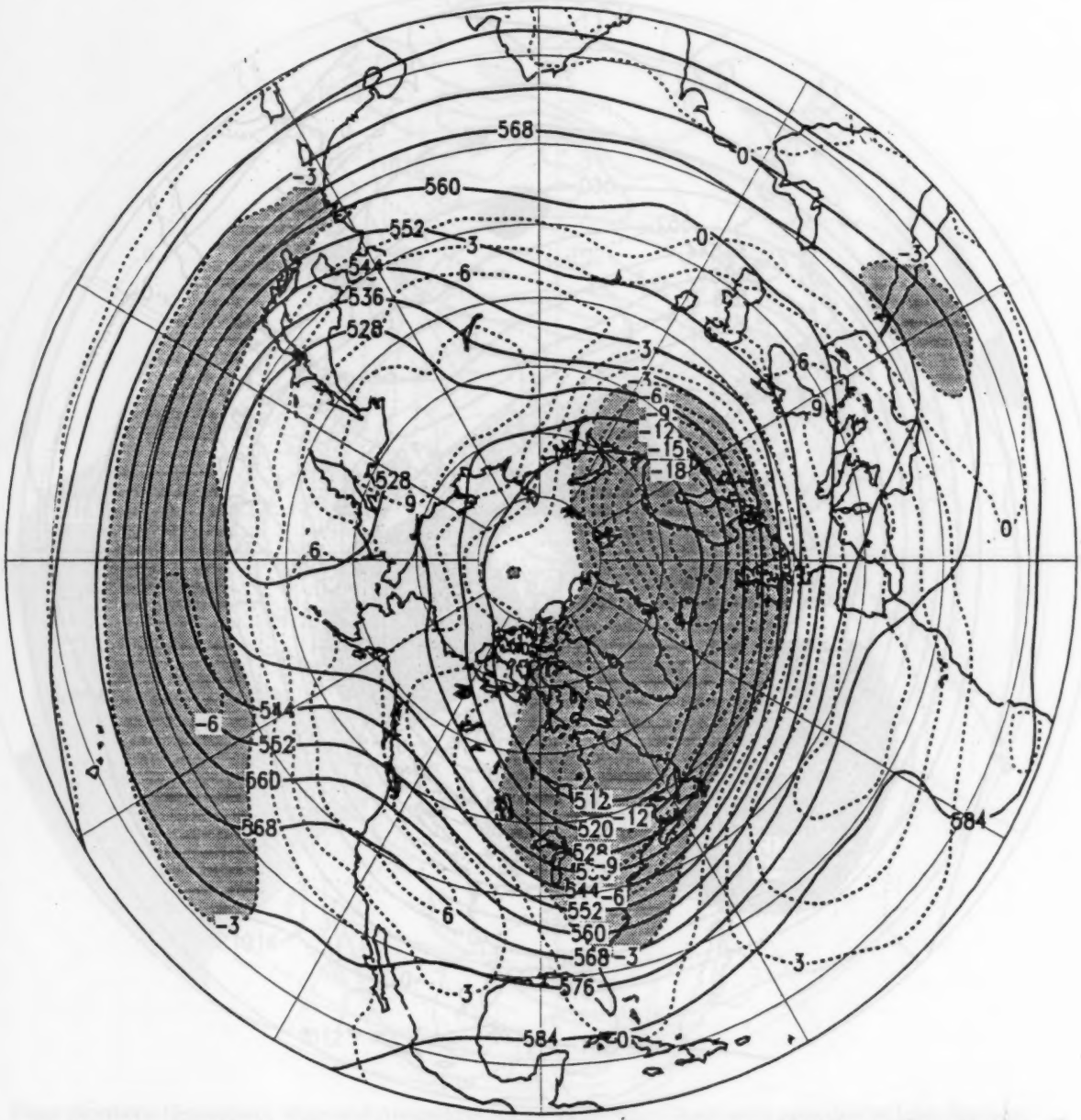
These Northern Hemisphere Mean and Anomalous Sea Level Pressure Charts were provided by John Kopman and Vernon Kousky of the Climate Analysis Center from the Climate Diagnostics Bulletin. Mean values are denoted by solid contours drawn at intervals of 4 millibars. Anomalies (contour intervals of 2 millibars) are departures from the 1979–1988 base period monthly means. Negative anomalies of less than 2 millibars are indicated by the dark shading while positive anomalies of greater than 2 millibars are indicated by the light shading. The analysis should be treated with caution in regions of elevated terrain.

January 1995



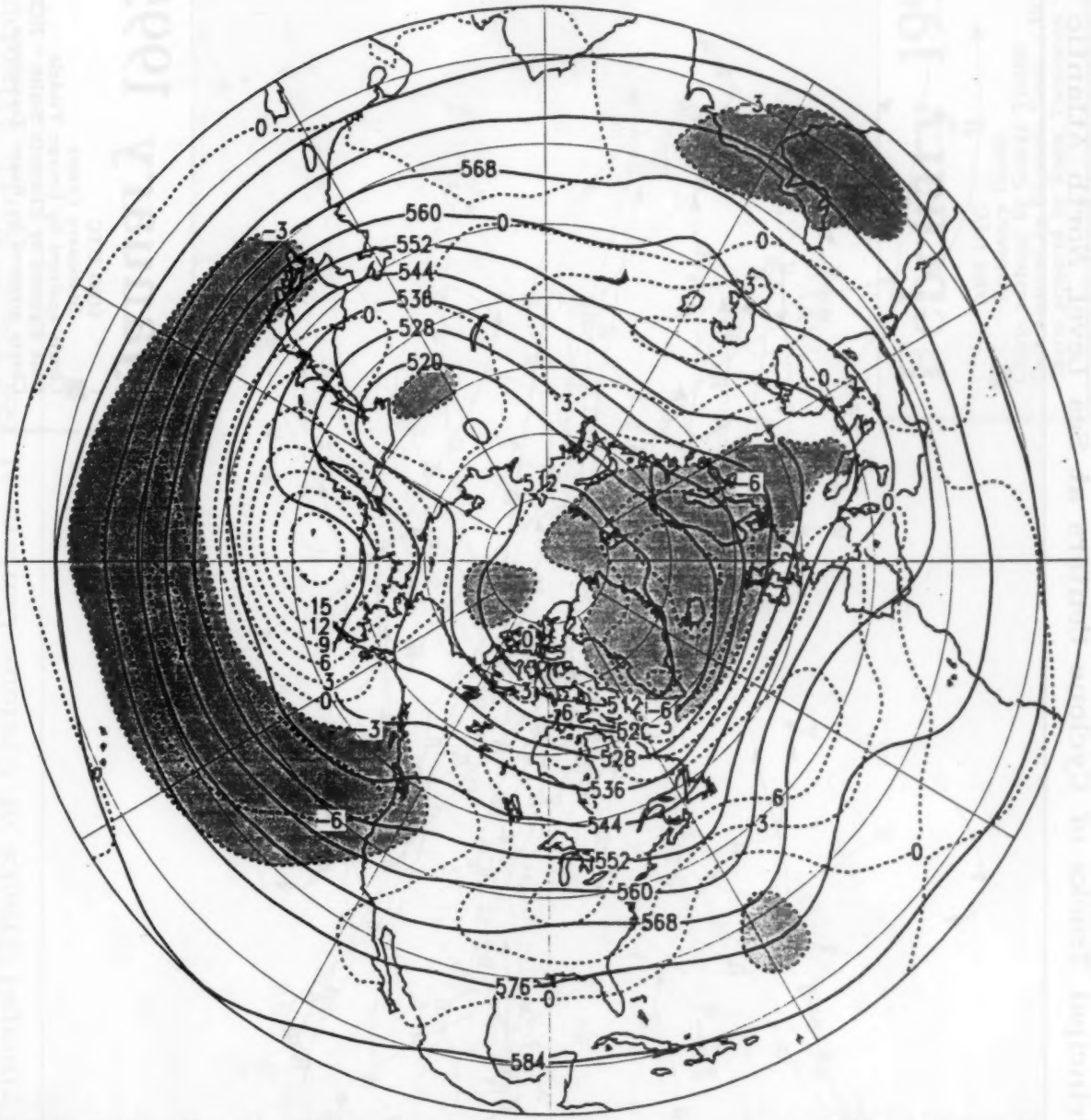
These Northern Hemisphere Mean and Anomalous 500-millibar Charts were provided by John Kopman and Vernon Kousky of the Climate Analysis Center from the Climate Diagnostics Bulletin. Mean geopotential values are denoted by solid contours drawn at intervals of 8 dynamic meters. Anomalies (contour intervals of 3 dynamic meters) are departures from the 1979-1988 base period monthly means. Negative anomalies of less than 3 dynamic meters are indicated by the dark shading while positive anomalies of greater than 3 dynamic meters are indicated by the light shading.

February 1995



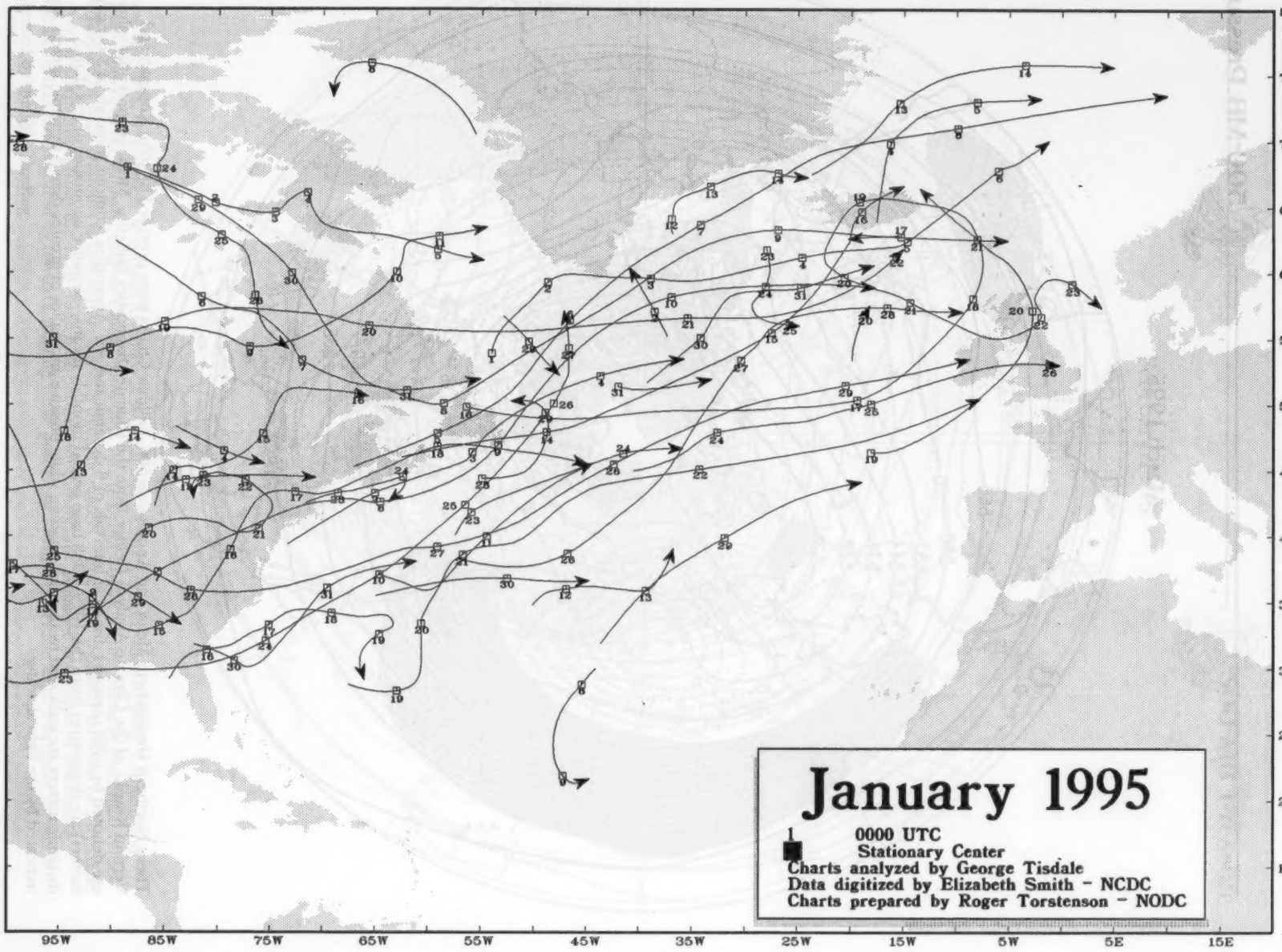
These Northern Hemisphere Mean and Anomalous 500–millibar Charts were provided by John Kopman and Vernon Kousky of the Climate Analysis Center from the Climate Diagnostics Bulletin. Mean geopotential values are denoted by solid contours drawn at intervals of 8 dynamic meters. Anomalies (contour intervals of 3 dynamic meters) are departures from the 1979–1988 base period monthly means. Negative anomalies of less than 3 dynamic meters are indicated by the dark shading while positive anomalies of greater than 3 dynamic meters are indicated by the light shading.

March 1995

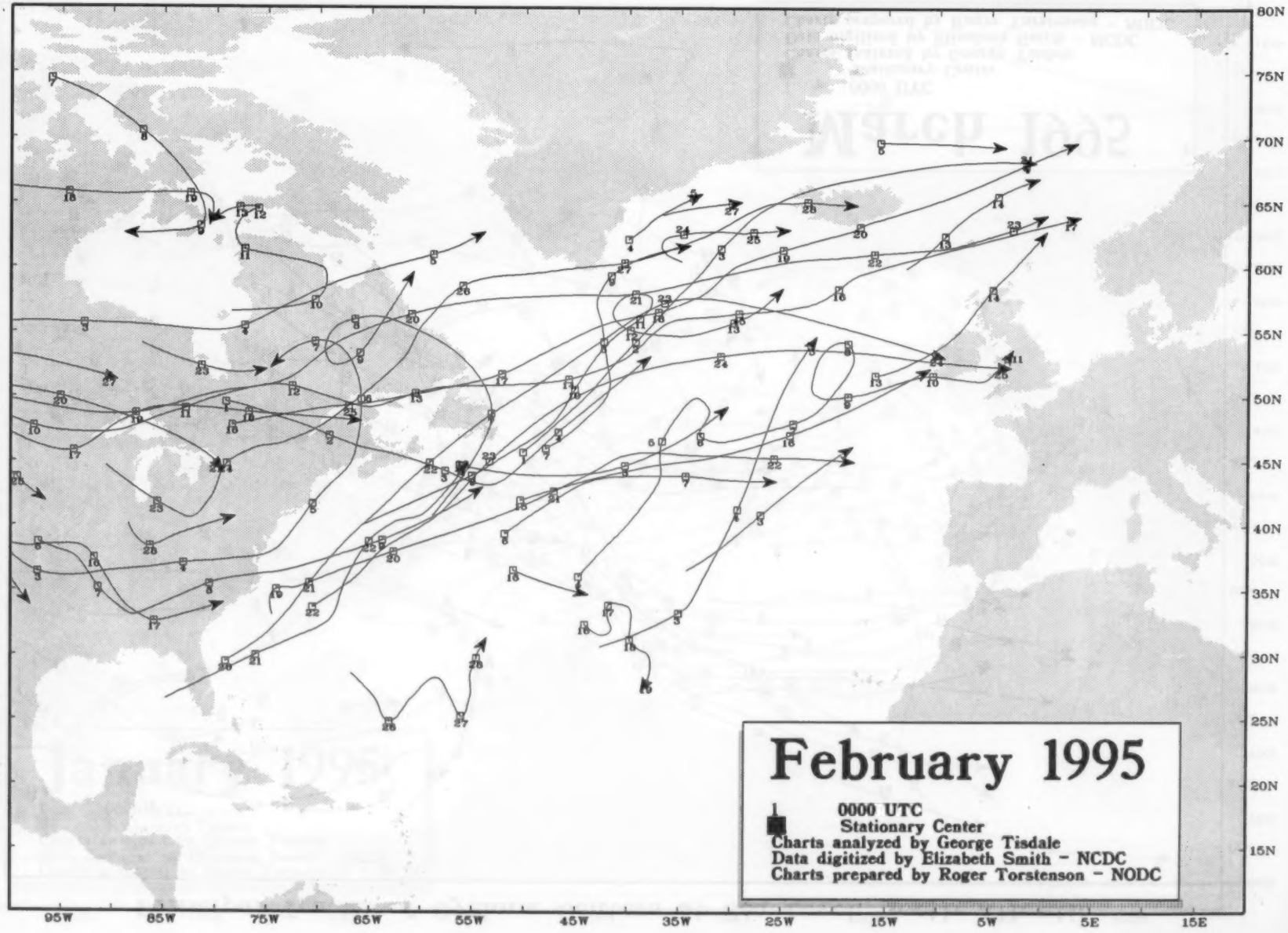


These Northern Hemisphere Mean and Anomalous 500-millibar Charts were provided by John Kopman and Vernon Kousky of the Climate Analysis Center from the Climate Diagnostics Bulletin. Mean geopotential values are denoted by solid contours drawn at intervals of 8 dynamic meters. Anomalies (contour intervals of 3 dynamic meters) are departures from the 1979-1988 base period monthly means. Negative anomalies of less than 3 dynamic meters are indicated by the dark shading while positive anomalies of greater than 3 dynamic meters are indicated by the light shading.

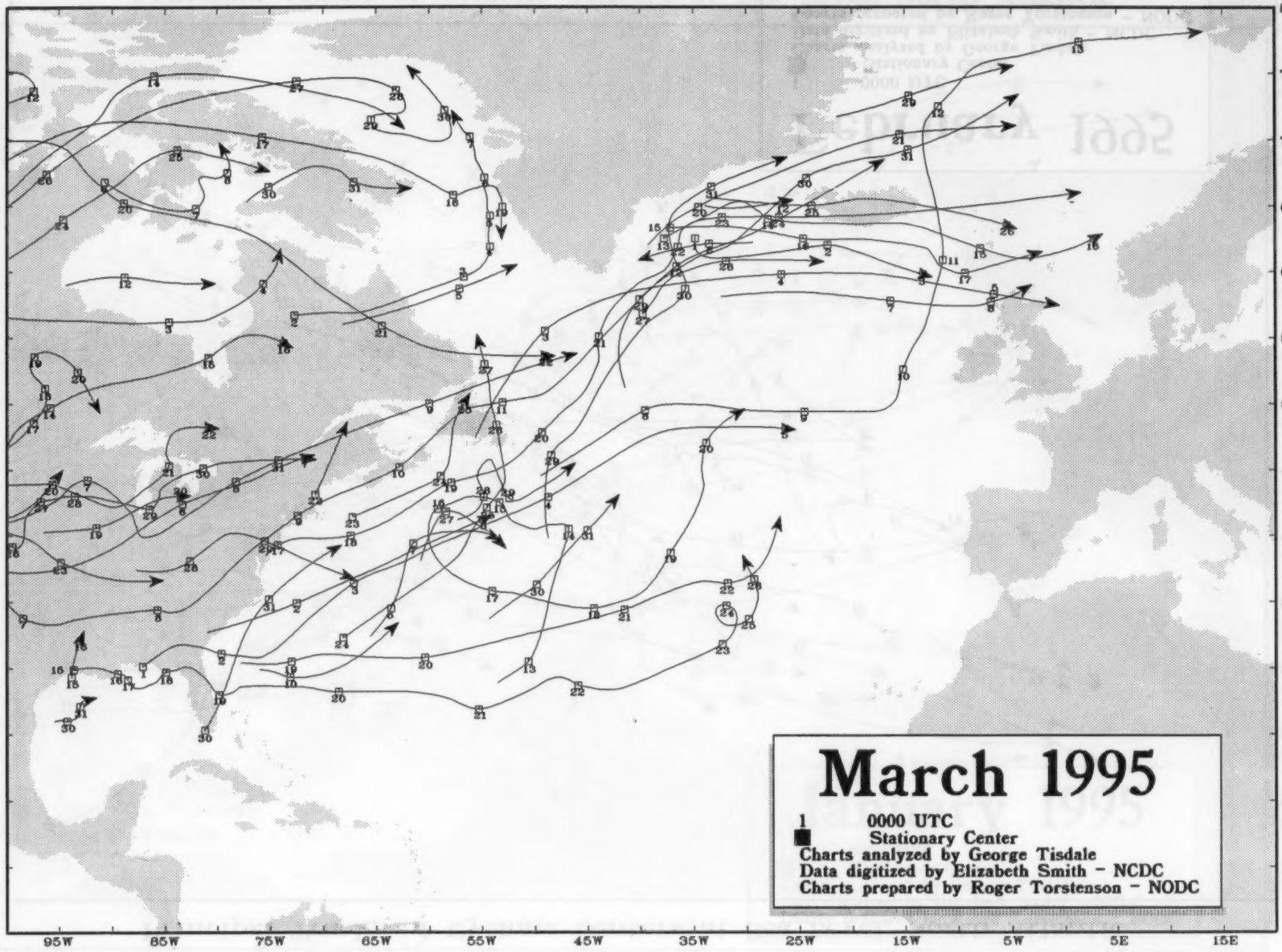
Principal Tracks of Cyclone Centers at Sea Level, North Atlantic



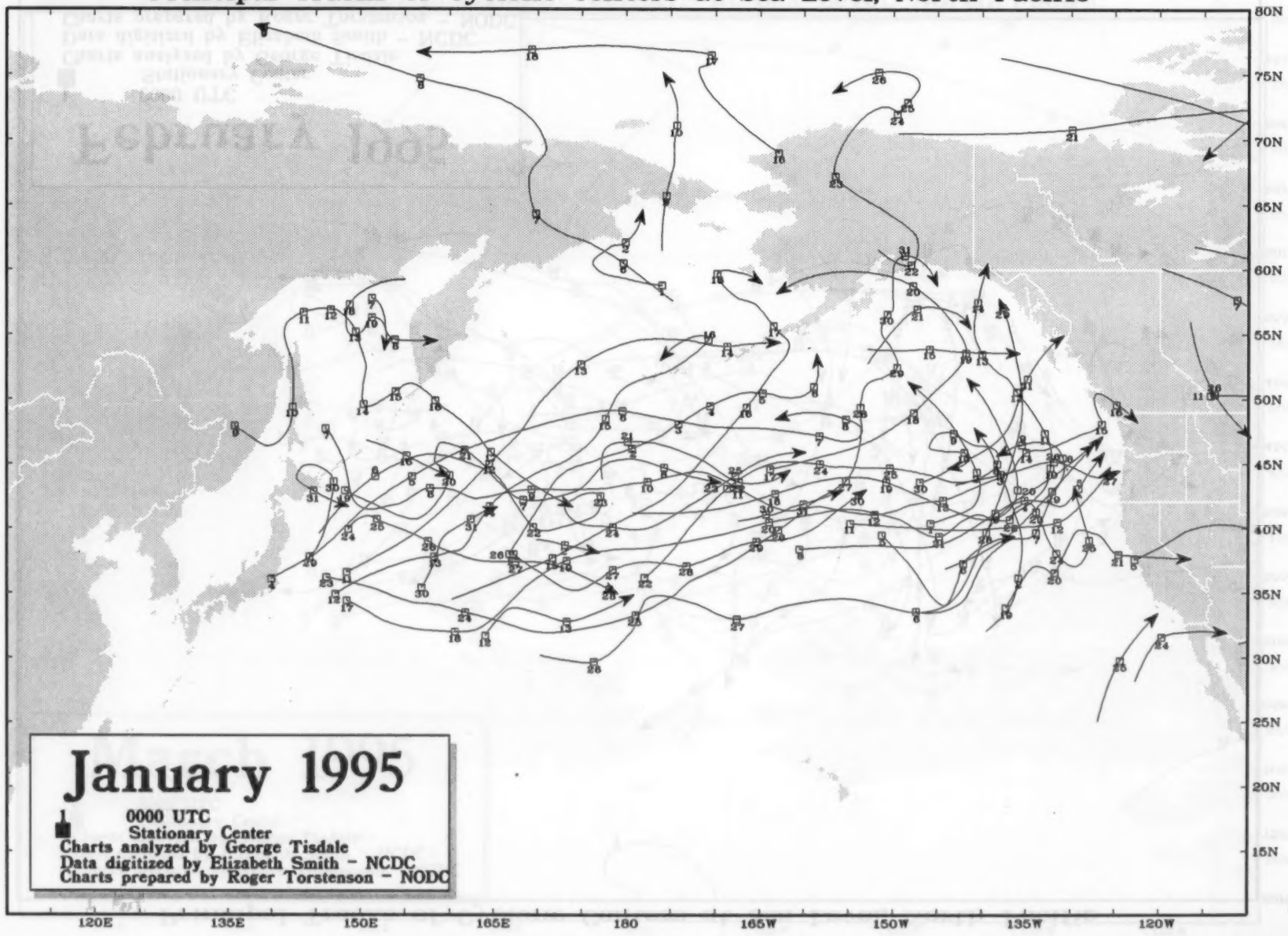
Principal Tracks of Cyclone Centers at Sea Level, North Atlantic



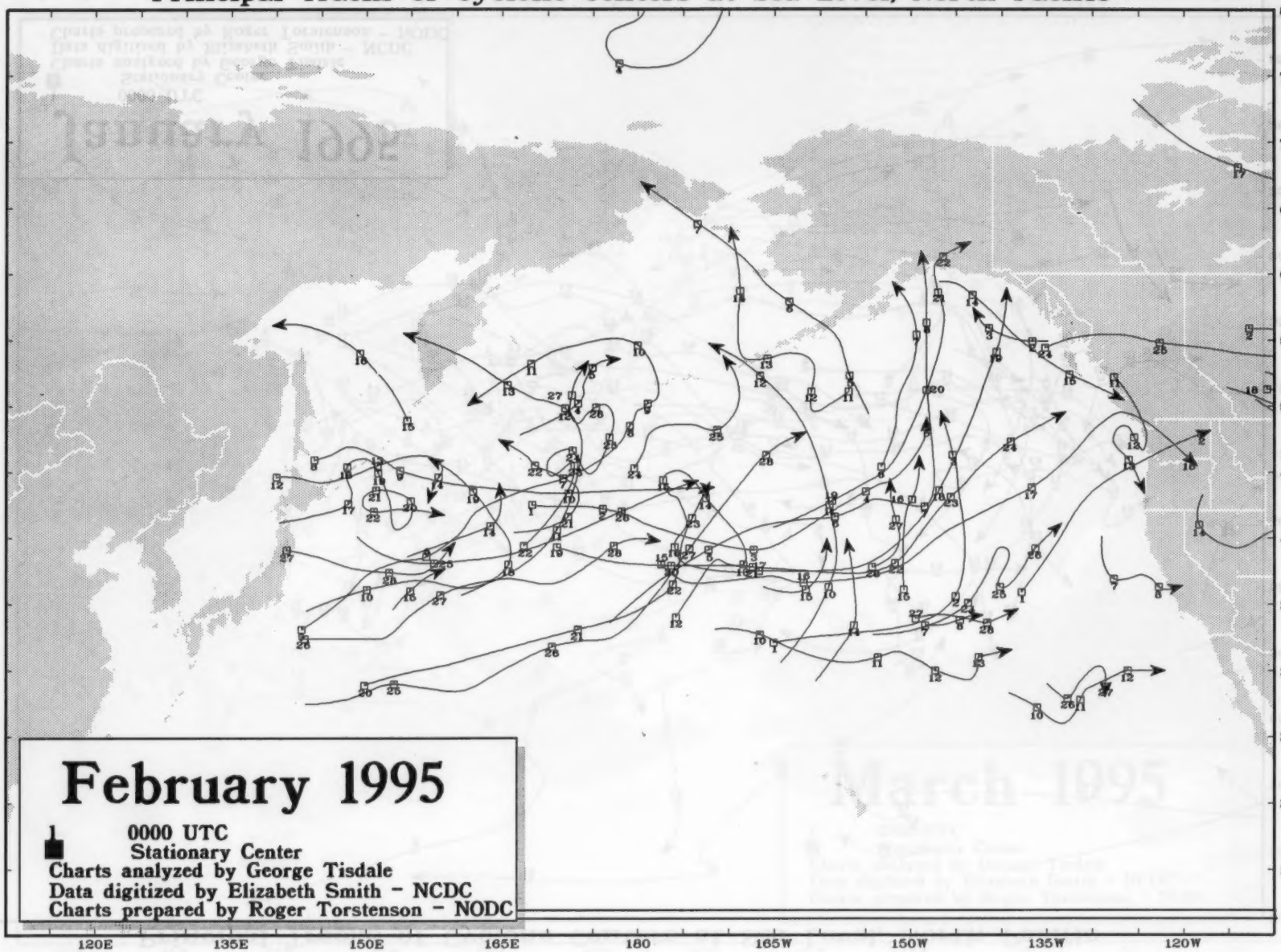
Principal Tracks of Cyclone Centers at Sea Level, North Atlantic



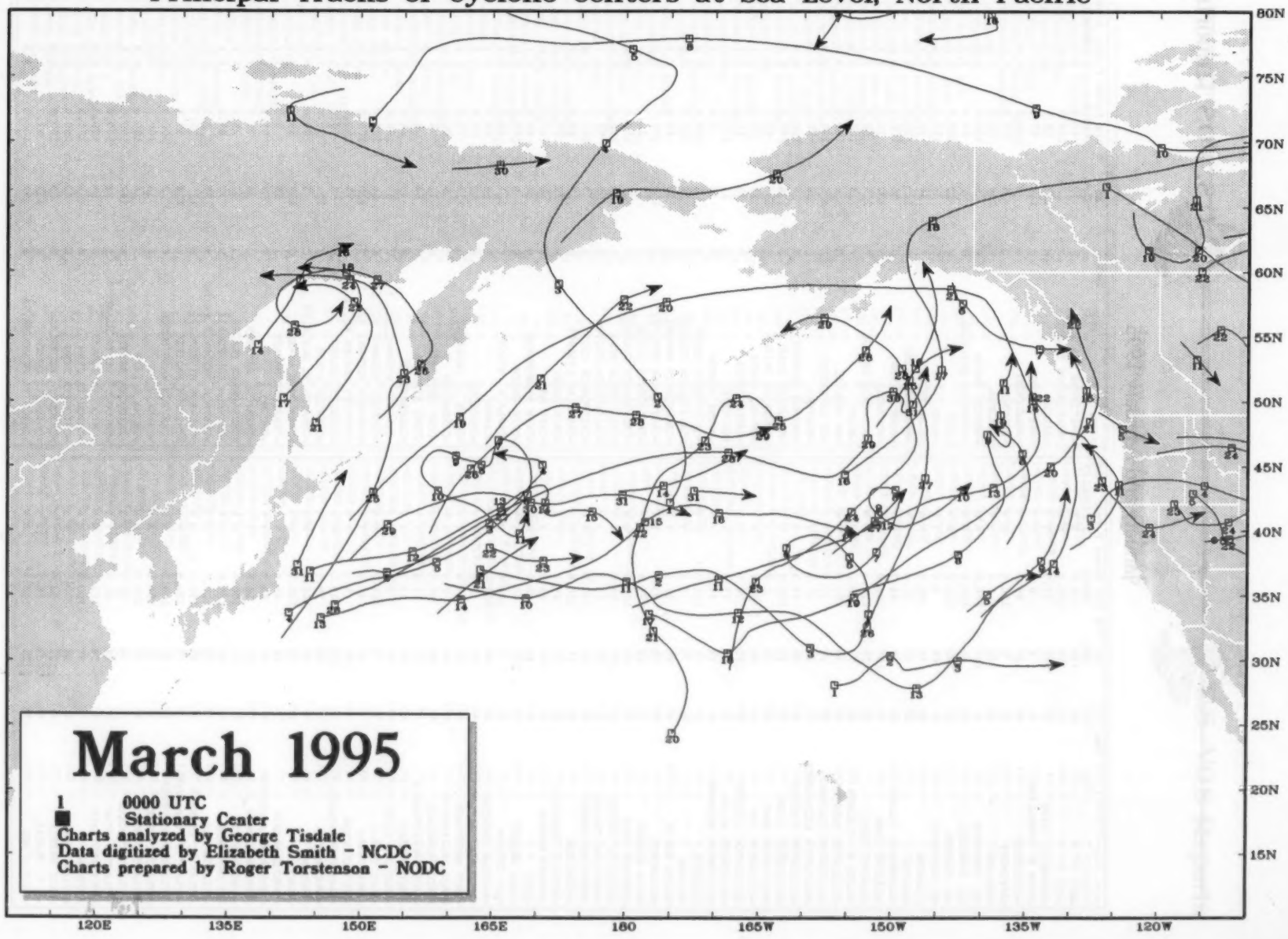
Principal Tracks of Cyclone Centers at Sea Level, North Pacific



Principal Tracks of Cyclone Centers at Sea Level, North Pacific



Principal Tracks of Cyclone Centers at Sea Level, North Pacific



January and February 1995

	PMO	No. Obs.	% via Radio	Forms J	Y-yes; N-no F(month)
>ACT 7	J	134	100.0	N	N
>ACT I	J	118	100.0	N	N
>ADABELLE LYKES	O	113	57.5	Y	Y
>ADAM E. CORNELIUS	G	6	0.0	Y	Y
>ADVANTAGE	N	47	89.3	Y	Y
>AFFINITY	M	9	100.0	N	N
>AGULHAS	B	122	0.0	Y	Y
>AL SAMIDOON	U	147	100.0	N	N
>AL SHUHADAA	U	47	100.0	N	N
>AL TAHREER	U	122	100.0	N	N
>AL WATTAYAH	B	65	0.0	Y	Y
>ALABAMA	M	11	100.0	N	N
>ALASKA	U	53	26.4	Y	Y
>ALBEMARLE ISLAND	J	38	44.7	Y	Y
>ALBERNI DAWN	U	107	100.0	N	N
>ALBERTO TOPIC	N	15	100.0	N	N
>ALDEN W. CLAUSEN	N	77	100.0	N	N
>ALLIGATOR AMERICA	S	39	100.0	N	N
>ALLIGATOR COLUMBUS	S	64	60.9	Y	Y
>ALLIGATOR EXCELLENCE	T	40	57.5	Y	Y
>ALLIGATOR FORTUNE	S	88	78.4	Y	Y
>ALLIGATOR GLORY	S	48	100.0	N	N
>ALLIGATOR HOPE	S	98	0.0	Y	Y
>ALLIGATOR JOY	S	66	98.4	Y	Y
>ALLIGATOR LIBERTY	S	118	100.0	N	N
>ALLIGATOR PRIDE	F	44	75.0	Y	Y
>ALLIGATOR TRIUMPH	T	34	97.0	Y	Y
>ALMANIA	J	1	100.0	N	N
>ALPENA	C	9	0.0	Y	Y
>ALPHA HELIX	S	51	33.3	Y	Y
>ALTAMONTE	T	29	82.7	Y	Y
>ALVA MAERSK	S	64	75.0	Y	Y
>AMERICA STAR	U	63	100.0	N	N
>AMERICAN CONDOR	J	105	59.0	Y	Y
>AMERICAN FALCON	K	75	69.3	Y	Y
>AMERICAN OSPREY	N	13	100.0	N	N
>AMERICANA	N	11	100.0	N	N
>AMERIGO VESPUCCI	N	71	49.2	Y	Y
>ANDERS MAERSK	T	147	63.9	Y	Y
>ANNA	K	46	100.0	N	N
>ANNA MAERSK	T	201	65.1	Y	Y
>APJ SHALIN	T	9	100.0	N	N
>ARABIAN SENATOR	N	87	100.0	N	N
>ARCO ALASKA	T	27	0.0	Y	Y
>ARCO ANCHORAGE	T	27	81.4	Y	Y
>ARCO CALIFORNIA	T	67	2.9	Y	Y
>ARCO FAIRBANKS	T	24	50.0	Y	Y
>ARCO INDEPENDENCE	T	36	19.4	Y	Y
>ARCO JUNEAU	T	18	33.3	Y	Y
>ARCO SAG RIVER	T	27	0.0	Y	Y
>ARCO SPIRIT	T	8	100.0	N	N
>ARCO TEXAS	T	32	81.2	Y	Y
>ARCTIC OCEAN	J	139	0.0	Y	Y
>ARCTIC UNIVERSAL	B	130	100.0	N	N
>ARGONAUT	J	96	39.5	Y	Y
>ARIZONA	K	32	100.0	N	N
>ARMCO	C	13	100.0	N	N
>ARNOLD MAERSK	J	46	45.6	Y	Y
>ARTHUR M. ANDERSON	G	26	80.7	Y	Y
>ARTHUR MAERSK	T	81	14.8	Y	Y
>ASHLEY LYKES	O	10	100.0	N	N
>ATIGUN PASS	T	40	65.0	Y	Y
>ATLANTA BAY	U	35	100.0	N	N
>ATLANTIC COMPASS	N	51	100.0	N	N
>ATLANTIC COMPANION	J	13	100.0	N	N
>ATLANTIC CONVEYOR	N	81	100.0	N	N
>ATLANTIC ERIE	B	41	100.0	N	N
>ATLANTIC HURON	B	13	100.0	N	N
>ATLANTIC OCEAN	J	54	98.1	Y	Y
>ATLANTIC STAR	B	24	91.6	Y	Y
>AUCKLAND STAR	B	34	100.0	N	N
>AUTHOR	U	81	100.0	N	N
>AVILA STAR	B	54	100.0	N	N
>AXEL MAERSK	F	122	54.9	Y	Y
>B.T. ALASKA	T	143	58.7	Y	Y
>BALTIC SUN	B	121	100.0	N	N

	PMO	No. Obs.	% via Radio	Forms J	Y-yes; N-no F(month)
>BALTIMORE TRADER	U	70	42.8	Y	Y
>BARRINGTON ISLAND	J	12	100.0	N	N
>BAUCHI	M	135	58.5	Y	Y
>BAY BRIDGE	S	114	57.8	Y	Y
>BEBEDOURO	J	79	100.0	N	N
>BELGRANO	U	74	50.0	Y	Y
>BELLONA	K	264	56.0	Y	Y
>BERGEN ARROW	B	46	100.0	N	N
>BERNARDO QUINTANA A	O	92	93.4	Y	Y
>BIBI	U	13	100.0	N	N
>BLED	S	35	100.0	N	N
>BLUE RIDGE	F	86	30.2	Y	Y
>BOGASARI LIMA	S	115	100.0	N	N
>BONN EXPRESS	U	85	100.0	N	N
>BORINGIA	N	302	73.1	Y	Y
>BOSPORUS BRIDGE	F	219	58.9	Y	Y
>BOVEC	T	14	100.0	N	N
>BP ADMIRAL	U	106	100.0	N	N
>BP ADVENTURE	S	105	100.0	N	N
>BRAVERY	F	34	88.2	Y	Y
>BREMEN EXPRESS	N	39	100.0	N	N
>BRISBANE STAR	S	124	100.0	N	N
>BROOKLYN BRIDGE	F	136	85.2	Y	Y
>BROOKS RANGE	T	19	63.1	Y	Y
>BRUCE SMART	F	78	15.3	Y	Y
>BUCKEYE	C	13	100.0	N	N
>BURNS HARBOR	G	18	5.5	Y	Y
>CALIFORNIA CERES	T	1	100.0	N	N
>CALIFORNIA CURRENT	O	78	100.0	N	N
>CALIFORNIA HERMES	S	50	84.0	Y	Y
>CALIFORNIA MERCURY	S	158	100.0	N	N
>CALIFORNIA ORION	T	47	48.9	Y	Y
>CALIFORNIA PEGASUS	F	76	100.0	N	N
>CALIFORNIA STAR	T	58	100.0	N	N
>CALIFORNIA TRITON	T	100	50.0	Y	Y
>CALIFORNIA ZEUS	S	19	100.0	N	N
>CANADIAN LIBERTY	B	37	48.6	Y	Y
>CAPE HENRY	N	22	100.0	N	N
>CAPE MAY	N	40	100.0	N	N
>CAPE WASHINGTON	B	11	45.4	Y	Y
>CAPE WRATH	B	8	100.0	N	N
>CARLA A. HILLS	F	121	68.5	Y	Y
>CARMEL	T	66	16.6	Y	Y
>CAROLINA	K	42	23.8	Y	Y
>CASON J. CALLAWAY	G	112	75.8	Y	Y
>CAVENDISH	U	8	100.0	N	N
>CCNI ANTARTICO	M	31	74.1	Y	Y
>CCNI ATACAMA	M	54	18.5	Y	Y
>CELEBRATION	M	45	64.4	Y	Y
>CENTURY HIGHWAY_NO. 3	U	85	100.0	N	N
>CENTURY HIGHWAY NO. 5	K	86	100.0	N	N
>CENTURY HIGHWAY #2	T	110	100.0	N	N
>CENTURY LEADER NO. 1	U	77	100.0	N	N
>CHARLES ISLAND	M	84	0.0	Y	Y
>CHARLES LYKES	B	124	50.0	Y	Y
>CHARLES M. BEEGHLEY	C	5	100.0	N	N
>CHARLOTTE LYKES	U	138	39.1	Y	Y
>CHASTINE MAERSK	J	55	0.0	Y	Y
>CHC NO.1	S	57	61.4	Y	Y
>CHEMICAL PIONEER	U	36	75.0	Y	Y
>CHESAPEAKE TRADER	U	43	93.0	Y	Y
>CHEVRON CALIFORNIA	F	47	89.3	Y	Y
>CHEVRON EMPLOYEE PRIDE	B	79	2.5	Y	Y
>CHEVRON MISSISSIPPI	F	115	81.7	Y	Y
>CHEVRON PACIFIC	F	126	39.6	Y	Y
>CHEVRON WASHINGTON	F	2	100.0	N	N
>CHINA HOPE	S	14	100.0	N	N
>CHINA SPIRIT	S	8	100.0	N	N
>CHIQUITA BELGIE	B	144	100.0	N	N
>CHIQUITA DEUTSCHLAND	B	81	100.0	N	N
>CHIQUITA ITALIA	B	99	100.0	N	N
>CHIQUITA JEAN	K	138	100.0	N	N
>CHIQUITA KING	K	69	100.0	N	N
>CHIQUITA NEDERLAND	B	69	100.0	N	N
>CHIQUITA QUEEN	K	137	92.7	Y	Y
>CHIQUITA SCANDINAVIA	B	92	100.0	N	N

January and February 1995

PMO		No. Obs.	% via Radio	Forms J	Y-yes; N-no F(month)
>CHIQUITA SCHWEIZ	B	106	100.0	N	N
>CIELO DI FIRENZE	T	24	100.0	N	N
>CLEMENTINA	T	1	100.0	N	N
>CLEVELAND	U	76	39.4	Y	Y
>COAST RANGE	F	41	0.0	Y	Y
>COASTAL EAGLE POINT	U	2	100.0	N	N
>COASTAL MANATEE	K	67	71.6	Y	Y
>COLIMA	T	108	100.0	N	N
>COLORADO	M	60	96.6	Y	Y
>COLUMBIA BAY	U	73	100.0	N	N
>COLUMBIA STAR	T	153	96.7	Y	Y
>COLUMBUS AMERICA	N	130	100.0	N	N
>COLUMBUS AUSTRALIA	U	36	100.0	N	N
>COLUMBUS CALIFORNIA	T	134	100.0	N	N
>COLUMBUS CANADA	T	394	97.7	Y	Y
>COLUMBUS NEW ZEALAND	J	59	100.0	N	N
>COLUMBUS QUEENSLAND	N	4	100.0	N	N
>COLUMBUS VICTORIA	T	124	100.0	N	N
>CONCERT EXPRESS	N	64	100.0	N	N
>CONDOLEEZZA RICE	B	36	8.3	Y	Y
>CONTIENTAL WING	T	44	100.0	N	N
>CONTSHIP AUSTRALIA	N	28	100.0	N	N
>CONTSHIP ENGLAND	U	35	100.0	N	N
>CORAH ANN	U	61	45.9	Y	Y
>CORNELIA MAERSK	N	89	96.6	Y	Y
>CORNELIS VEROLME	B	13	100.0	N	N
>CORNUCOPIA	F	80	83.7	Y	Y
>CORONADO	K	1	100.0	N	N
>CORPUS CHRISTI	U	53	20.7	Y	Y
>COURIER	U	17	0.0	Y	Y
>COURTNEY BURTON	C	10	70.0	Y	Y
>COURTNEY L.	B	106	92.4	Y	Y
>CPL. LOUIS J. HAUGE JR	N	15	46.6	Y	Y
>CRIMMITSCHAU	U	9	100.0	N	N
>CRISTOFORO COLOMBO	N	19	100.0	N	N
>CROWN JEWEL	M	204	0.0	Y	Y
>CSL ATLAS	B	140	100.0	N	N
>DEL MONTE CONSUMER	B	29	93.1	Y	Y
>DEL MONTE PACKER	K	71	28.1	Y	Y
>DEL MONTE TRADER	B	65	0.0	Y	Y
>DELAWARE TRADER	T	96	85.4	Y	Y
>DELMONTE PLANTER	M	55	0.0	Y	Y
>DELMONTE TRANSPORTER	M	42	97.6	Y	Y
>DENALI	T	143	100.0	N	N
>DIRECT EAGLE	T	48	100.0	N	N
>DIRECT KIWI	T	60	100.0	N	N
>DIRECT KOOKABURRA	T	55	100.0	N	N
>DOCTOR LYKES	B	128	88.2	Y	Y
>DOROTHEA OLDENDORFF	S	38	52.6	Y	Y
>DOUBLE GLORY	J	22	100.0	N	N
>DSR BALTIC	N	72	100.0	N	N
>DSR EUROPE	N	26	100.0	N	N
>DSR PACIFIC	T	104	100.0	N	N
>DUSSELDORF EXPRESS	J	67	100.0	N	N
>DYVI OCEANIC	K	25	100.0	N	N
>EASTERN LION	T	36	100.0	N	N
>ECSTASY	M	21	95.2	Y	Y
>EDELWIESS	S	68	100.0	N	N
>EDGAR B. SPEER	G	27	3.7	Y	Y
>EDINBURGH FRUID	U	13	100.0	N	N
>EDWIN H. GOTT	G	72	1.3	Y	Y
>EDYTH L.	B	78	94.8	Y	Y
>EIBE OLDENDORFF	S	138	97.1	Y	Y
>ELIZABETH LYKES	O	55	41.8	Y	Y
>ELLEN HUDIG	B	22	100.0	N	N
>ELLEN KNUDSEN	N	29	96.5	Y	Y
>ELLENSBORG	M	21	0.0	Y	Y
>ELSBORG	M	65	0.0	Y	Y
>EMMA OLDENDORFF	S	2	100.0	N	N
>ENCHANTED SEAS	O	18	66.6	Y	Y
>ENDEAVOR 2	S	40	100.0	N	N
>EUROPEAN SENATOR	N	39	100.0	N	N
>EVER GAINING	N	13	92.3	Y	Y
>EVER GALLANT	N	8	100.0	N	N
>EVER GARDEN	N	8	100.0	N	N
>EVER GARLAND	T	43	95.3	Y	Y

PMO		No. Obs.	% via Radio	Forms J	Y-yes; N-no F(month)
>EVER GENTLE	J	8	100.0	N	N
>EVER GIANT	T	1	100.0	N	N
>EVER GLAMOUR	T	19	47.3	Y	Y
>EVER GLEAMY	J	1	100.0	N	N
>EVER GLEEFUL	T	14	100.0	N	N
>EVER GLORY	J	7	100.0	N	N
>EVER GOLDEN	B	11	100.0	N	N
>EVER GOODS	J	8	12.5	Y	Y
>EVER GRADE	J	17	100.0	N	N
>EVER GROUP	T	2	100.0	N	N
>EVER GUARD	S	9	66.6	Y	Y
>EVER GUIDE	T	5	100.0	N	N
>EVER LAUREL	T	15	100.0	N	N
>EVER LIVING	S	14	100.0	N	N
>EVER LOADING	J	33	51.5	Y	Y
>EVER RACER	N	22	0.0	Y	Y
>EVER RENOWN	T	16	100.0	N	N
>EVER ROUND	T	16	100.0	N	N
>EXPORT FREEDOM	J	68	54.4	Y	Y
>EXPORT PATRIOT	J	63	49.2	Y	Y
>FAIRMAST	N	147	100.0	N	N
>FALSTRIA	S	102	100.0	N	N
>FARALLON ISLAND	F	244	100.0	N	N
>FASINATION	M	120	51.6	Y	Y
>FAUST	K	100	42.0	Y	Y
>FEDERAL SKEENA	O	35	74.2	Y	Y
>FERIDA	N	3	100.0	N	N
>FERNCROFT	T	53	26.4	Y	Y
>FESTIVALE	M	78	0.0	Y	Y
>FETISH	N	91	100.0	N	N
>FIDELIO	K	145	33.1	Y	Y
>FIR GROVE	S	116	25.0	Y	Y
>FRANCES HAMMER	K	44	100.0	N	N
>FRANCES L.	B	115	96.5	Y	Y
>FRED G.	O	137	25.5	Y	Y
>FRED R. WHITE JR	C	22	100.0	N	N
>FREDERICKSBURG	U	56	55.3	Y	Y
>FREJA SVEA	Y	22	86.3	Y	Y
>FRINES	U	29	100.0	N	N
>GALVESTON BAY	U	121	98.3	Y	Y
>GENEVIEVE LYKES	O	22	100.0	N	N
>GEORGE A. STINSON	C	19	73.6	Y	Y
>GEORGE H. WEYERHAEUSER	F	97	68.0	Y	Y
>GEORGE SCHULTZ	B	26	100.0	N	N
>GEORGE WASHINGTON BRID	T	139	100.0	N	N
>GEORGIA RAINBOW II	K	139	37.4	Y	Y
>GLOBAL MARINER	B	19	100.0	N	N
>GLOBAL SENTINEL	B	21	33.3	Y	Y
>GOLDEN APO	S	33	84.8	Y	Y
>GOLDEN GATE BRIDGE	S	145	94.4	Y	Y
>GOLDEN GATE	T	13	15.3	Y	Y
>GOLDEN MONARCH	K	27	66.6	Y	Y
>GREAT LAND	S	100	96.0	Y	Y
>GREEN HARBOUR	O	30	30.0	Y	Y
>GREEN ISLAND	O	29	100.0	N	N
>GREEN LAKE	B	110	59.0	Y	Y
>GREEN MAYA	S	104	35.5	Y	Y
>GREEN RIDGE	S	29	17.2	Y	Y
>GREEN SASEBO	S	130	43.8	Y	Y
>GREEN SUMA	S	153	12.4	Y	Y
>GREEN SYLVAN	S	26	100.0	N	N
>GREEN VALLEY	U	19	26.3	Y	Y
>GROWTH RING	S	83	100.0	N	N
>GUAYAMA	K	136	45.5	Y	Y
>GULF CURRENT	U	27	100.0	N	N
>GULF SPIRIT	U	67	100.0	N	N
>GYPSUM BARON	N	115	100.0	N	N
>GYPSUM KING	M	75	100.0	N	N
>HANJIN BARCELONA	T	13	100.0	N	N
>HANJIN BREMEN	S	12	100.0	N	N
>HANJIN CHUNGMU	S	40	100.0	N	N
>HANJIN ELIZABETH	F	3	100.0	N	N
>HANJIN FELIXSTOWE	S	8	100.0	N	N
>HANJIN HONG KONG	T	12	100.0	N	N
>HANJIN KOBE	T	29	100.0	N	N
>HANJIN MARSEILLES	F	18	100.0	N	N

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	PMO	No. Obs.	% via Radio	Forms Y-yes; N-no J F(month)
>HANJIN NEW YORK	T	32	100.0	N N
>HANJIN OAKLAND	T	11	100.0	N N
>HANJIN ROTTERDAM	S	5	100.0	N N
>HANJIN SEATTLE	S	11	100.0	N N
>HANJIN TONGHAE	S	34	100.0	N N
>HANJIN VANCOUVER	T	14	100.0	N N
>HANJIN YOKOHAMA	T	40	100.0	N N
>HANSA LUBECK	T	1	100.0	N N
>HEIDELBERG EXPRESS	U	64	100.0	N N
>HEIJIN	K	117	9.4	Y Y
>HENRY HUDSON BRIDGE	T	126	98.4	Y Y
>HERBERT C. JACKSON	C	15	73.3	Y Y
>HERMOD	U	98	100.0	N N
>HESIOD	U	89	100.0	N N
>HIBISCUS II	B	146	16.4	Y Y
>HOEGH CAIRN	B	19	0.0	Y Y
>HOEGH CLIPPER	S	24	58.3	Y Y
>HOEGH DRAKE	N	9	100.0	N N
>HOEGH DUKE	N	32	46.8	Y Y
>HOEGH DYKE	T	13	100.0	N N
>HOEGH MERCHANT	S	2	100.0	N N
>HOLIDAY	M	32	100.0	N N
>HOWELL LYKES	S	65	53.8	Y Y
>HUAL ANGELITA	K	1	100.0	N N
>HUAL ROLITA	K	16	43.7	Y Y
>HUMACAO	N	3	33.3	Y Y
>HYUNDAI COMMANDER	T	11	0.0	Y Y
>HYUNDAI DUKE	T	21	95.2	Y Y
>HYUNDAI EMPERIOR	T	16	100.0	N N
>HYUNDAI PORTLAND	S	43	100.0	N N
>HYUNDAI VANCOUVER	S	39	100.0	N N
>INDIAN GOODWILL	O	8	100.0	N N
>INDIAN OCEAN	J	58	93.1	Y Y
>INDIANA HARBOR	C	6	100.0	N N
>INGER	U	28	21.4	Y Y
>ISLAND PRINCESS	T	4	100.0	N N
>ITB BALTIMORE	J	17	100.0	N N
>ITB GROTON	J	59	79.6	Y Y
>ITB JACKSONVILLE	B	88	97.7	Y Y
>ITB MOBILE	J	39	97.4	Y Y
>ITB NEW YORK	J	61	100.0	N N
>ITB PHILADELPHIA	B	43	46.5	Y Y
>IVER EXPRESS	U	2	100.0	N N
>J. DENNIS BONNEY	B	39	2.5	Y Y
>JAHRE SPIRIT	U	8	100.0	N N
>JALISCO	U	80	70.0	Y Y
>JAMES LYKES	O	40	77.5	Y Y
>JAMES R. BARKER	C	15	100.0	N N
>JAPAN RAINBOW 2	S	87	52.8	Y Y
>JAPAN SENATOR	N	13	100.0	N N
>JASMINE	U	23	100.0	N N
>JEAN LYKES	U	71	45.0	Y Y
>JEBEL ALI	J	36	69.4	Y Y
>JO CLIPPER	B	57	100.0	N N
>JOHN G. MUNSON	G	18	100.0	N N
>JOHN LYKES	U	60	100.0	N N
>JOHN YOUNG	F	94	0.0	Y Y
>JOSEPH L. BLOCK	G	3	66.6	Y Y
>JUBILANT	K	28	64.2	Y Y
>JUBILEE	T	42	50.0	Y Y
>JULIUS HAMMER	K	82	81.7	Y Y
>JUPITER DIAMOND	B	44	100.0	N N
>KAIMOKU	T	141	92.1	Y Y
>KAINALU	T	84	86.9	Y Y
>KAKUSHIMA	S	83	49.3	Y Y
>KANSAS TRADER	U	13	92.3	Y Y
>KAUAI	F	148	43.2	Y Y
>KAYE E. BARKER	C	42	16.6	Y Y
>KAZIMAH	U	109	100.0	N N
>KENAI	U	119	24.3	Y Y
>KENNETH E. HILL	J	35	77.1	Y Y
>KENNETH T. DERR	J	10	100.0	N N
>KENTUCKY HIGHWAY	N	50	100.0	N N
>KEYSTONE CANYON	T	65	70.7	Y Y
>KITTANING	N	77	49.3	Y Y
>KOLN EXPRESS	J	278	100.0	N N

	PMO	No. Obs.	% via Radio	Forms Y-yes; N-no J F(month)
>KOPER EXPRESS	N	5	100.0	N N
>KURE	S	50	48.0	Y Y
>LA TRINITY	O	25	96.0	Y Y
>LAWRENCE H. GIANELLA	N	69	18.8	Y Y
>LEON	B	13	100.0	N N
>LEONARD J. COWLEY	N	84	100.0	N N
>LEONIA	U	98	100.0	N N
>LERMA	T	78	100.0	N N
>LESLIE LYKES	U	69	47.8	Y Y
>LIBERTY SPIRIT	C	59	50.8	Y Y
>LIBERTY STAR	O	3	0.0	Y Y
>LIBERTY SUN	N	69	71.0	Y Y
>LIBERTY VICTORY	S	33	18.1	Y Y
>LIBERTY WAVE	N	26	96.1	Y Y
>LIRCAY	U	109	56.8	Y Y
>LNG AQUARIUS	F	22	45.4	Y Y
>LNG CAPRICORN	Y	11	81.8	Y Y
>LNG LEO	Y	24	25.0	Y Y
>LNG VIRGO	Y	110	40.0	Y Y
>LONDON ENTERPRISE	U	111	100.0	N N
>LONDON SPIRIT	B	41	100.0	N N
>LONG LINES	B	4	100.0	N N
>LONGAVI	T	51	100.0	N N
>LOUISE LYKES	U	28	53.5	Y Y
>LT ARGOSY	C	15	100.0	N N
>LT PRAGATI	S	31	3.2	Y Y
>LT. ODYSSEY	C	12	100.0	N N
>LUCKY BULKER	N	8	100.0	N N
>LUNA MAERSK	S	98	56.1	Y Y
>LURLINE	F	92	43.4	Y Y
>MAASDAM	T	26	100.0	N N
>MACKINAC BRIDGE	T	89	100.0	N N
>MADISON MAERSK	F	70	51.4	Y Y
>MAERSK CONSTELLATION	F	94	14.8	Y Y
>MAERSK LA PLATA	U	62	100.0	N N
>MAERSK SUN	S	49	100.0	N N
>MAGIC	K	110	27.2	Y Y
>MAGLEBY MAERSK	J	82	53.6	Y Y
>MAJESTIC MAERSK	J	69	52.1	Y Y
>MANGAL DESAI	C	71	45.0	Y Y
>MANUKAI	F	95	48.4	Y Y
>MARATHA MAJESTY	T	19	100.0	N N
>MARCHEN MAERSK	T	58	29.3	Y Y
>MAREN MAERSK	T	60	46.6	Y Y
>MARGARET LYKES	U	67	47.7	Y Y
>MARGRETHE MAERSK	T	72	70.8	Y Y
>MARIE MAERSK	J	54	92.5	Y Y
>MARIF	S	32	78.1	Y Y
>MARINE RELIANCE	K	22	100.0	N N
>MARIT MAERSK	F	62	50.0	Y Y
>MARITIME TRAINING CENT	S	5	100.0	N N
>MARJORIE LYKES	O	96	21.8	Y Y
>MARLIN	O	114	0.0	Y Y
>MATHILDE MAERSK	T	67	25.3	Y Y
>MATSONIA	F	140	88.5	Y Y
>MAUI	T	140	77.8	Y Y
>MAURICE EWING	J	14	100.0	N N
>MAYAGUEZ	K	50	66.0	Y Y
>MAYVIEW MAERSK	F	76	30.2	Y Y
>MC-KINNEY MAERSK	J	67	52.2	Y Y
>MEDALLION	K	75	86.6	Y Y
>MEDUSA CHALLENGER	C	64	54.6	Y Y
>MELBOURNE STAR	J	1	100.0	N N
>MELVILLE	T	212	89.6	Y Y
>MERCANDIAN ARROW	M	78	2.5	Y Y
>MERCHANT PREMIER	S	94	100.0	N N
>MERCHANT PRINCE	U	8	100.0	N N
>MERCHANT PRINCIPAL	S	123	100.0	N N
>MERCURY DIAMOND	T	44	100.0	N N
>MERIDA	U	62	58.0	Y Y
>MESABI MINER	C	79	32.9	Y Y
>METTE MAERSK	T	100	48.0	Y Y
>MICHIGAN	G	158	24.6	Y Y
>MICHIGAN HIGHWAY	B	2	100.0	N N
>MICRONESIAN PRIDE	T	37	100.0	N N
>MIDDLETOWN	C	36	47.2	Y Y

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PMO		No. Obs.	% via Forms Radio	Y-yes; N-no J F(month)
>MINERAL OSPREY	M	24	100.0	N N
>MINERVA	N	4	100.0	N N
>MING PLEASURE	T	55	100.0	N N
>MING PROPITIOUS	J	47	100.0	N N
>MITLA	U	98	76.5	Y Y
>MOANA PACIFIC	T	47	100.0	N N
>MOANA WAVE	N	51	100.0	N N
>MOKU PAHU	F	11	100.0	N N
>MONTERREY	T	27	14.8	Y Y
>MORELOS	T	110	98.1	Y Y
>MORMACSKY	Y	8	0.0	Y Y
>MORMACSTAR	U	67	47.7	Y Y
>MORMACSUN	N	53	69.8	Y Y
>MT. CABRITE	T	66	100.0	N N
>MYSTIC	T	3	100.0	N N
>NACIONAL SANTOS	O	1	100.0	N N
>NACIONAL VITORIA	U	92	56.5	Y Y
>NATIONAL DIGNITY	T	29	89.6	Y Y
>NATIONAL HONOR	T	21	85.7	Y Y
>NATIONAL PRIDE	T	98	19.3	Y Y
>NEDLLOYD CLARENCE	S	1	100.0	N N
>NEDLLOYD HOLLAND	U	97	63.9	Y Y
>NEDLLOYD ROTTERDAM	J	5	100.0	N N
>NEDLLOYD VAN DIEMEN	T	11	100.0	N N
>NEDLLOYD VAN DAJIMA	U	57	100.0	N N
>NEDLLOYD VAN CLOON	T	47	100.0	N N
>NEDLLOYD VAN NECK	F	81	100.0	N N
>NEDLLOYD VAN NOORT	F	63	100.0	N N
>NEDLLOYS MAURITIUS	T	46	100.0	N N
>NEPTUNE ACE	T	94	100.0	N N
>NEPTUNE AMBER	S	359	8.9	Y Y
>NEPTUNE CORAL	T	7	100.0	N N
>NEPTUNE CRYSTAL	S	16	100.0	N N
>NEPTUNE DIAMOND	T	57	100.0	N N
>NEPTUNE GARNET	S	18	100.0	N N
>NEPTUNE JADE	N	17	100.0	N N
>NEPTUNE PEARL	T	20	100.0	N N
>NEPTUNE RHODONITE	T	29	68.9	Y Y
>NEW CARISSA	S	154	87.2	Y Y
>NEW HORIZON	T	62	50.0	Y Y
>NEWARK BAY	U	152	38.8	Y Y
>NEWPORT BRIDGE	F	49	100.0	N N
>NIEUW AMSTERDAM	T	38	100.0	N N
>NOAA DAVID STARR JORDA	S	93	0.0	Y Y
>NOAA SHIP ALBATROSS IV	N	193	89.6	Y Y
>NOAA SHIP CHAPMAN	O	196	64.7	Y Y
>NOAA SHIP DISCOVERER O	S	178	20.7	Y Y
>NOAA SHIP FERREL	N	6	0.0	Y Y
>NOAA SHIP M. BALDRIDGE	M	125	76.8	Y Y
>NOAA SHIP MILLER FREEM	S	149	26.8	Y Y
>NOAA SHIP OREGON II	O	318	94.3	Y Y
>NOAA SHIP SURVEYOR	S	262	39.3	Y Y
>NOBEL STAR	U	61	100.0	N N
>NOMADIC MERMAID	S	15	100.0	N N
>NORD JAHRE TARGET	B	116	100.0	N N
>NORTHERN LIGHTS	O	211	79.6	Y Y
>NORTHERN LION	T	125	96.8	Y Y
>NORWAY	M	101	55.4	Y Y
>NOSAC CEDAR	S	2	100.0	N N
>NOSAC EXPLORER	S	14	100.0	N N
>NOSAC EXPRESS	T	28	100.0	N N
>NOSAC RANGER	N	96	64.5	Y Y
>NOSAC TAI SHAN	K	46	56.5	Y Y
>NOSAC TAKAYAMA	J	92	64.1	Y Y
>NUEVO LEON	U	68	83.8	Y Y
>NUEVO SAN JUAN	N	78	24.3	Y Y
>NURNBERG ATLANTIC	N	729	100.0	N N
>NYK SEABREEZE	S	56	100.0	N N
>NYK SPRINGTIDE	U	95	100.0	N N
>NYK STARLIGHT	T	39	100.0	N N
>NYK SUNRISE	S	55	100.0	N N
>NYK SURFWIND	S	23	100.0	N N
>OAXACA	T	99	97.9	Y Y
>OBO ENGIN	T	34	55.8	Y Y
>OCEAN HIGHWAY	T	29	100.0	N N
>OCEAN SPIRIT	N	121	100.0	N N

PMO		No. Obs.	% via Forms Radio	Y-yes; N-no J F(month)
>OCEANUS OSAKA	J	69	47.8	Y Y
>ODELIA	S	24	87.5	Y Y
>OLIVE ACE	T	34	100.0	N N
>OLIVEBANK	B	37	100.0	N N
>OMI MISSOURI	K	67	47.7	Y Y
>OOCL BRAVERY	N	65	100.0	N N
>OOCL EDUCATOR	F	50	90.0	Y Y
>OOCL ENVOY	S	49	100.0	N N
>OOCL EXECUTIVE	S	56	91.0	Y Y
>OOCL EXPLORER	S	69	88.4	Y Y
>OOCL EXPORTER	S	73	100.0	N N
>OOCL FAIR	T	61	91.8	Y Y
>OOCL FAITH	N	51	100.0	N N
>OOCL FAME	U	37	100.0	N N
>OOCL FIDELITY	T	55	100.0	N N
>OOCL FORTUNE	T	135	74.8	Y Y
>OOCL FREEDOM	N	160	100.0	N N
>OOCL FRIENDSHIP	T	11	100.0	N N
>OOCL INNOVATION	N	115	40.8	Y Y
>OOCL INSPIRATION	U	70	100.0	N N
>ORANGE BLOSSOM	J	17	0.0	Y Y
>OREGON RAINBOW III	K	102	7.8	Y Y
>ORIENTE PRIME	S	5	0.0	Y Y
>ORION HIGHWAY	K	131	42.7	Y Y
>OURO DO BRASIL	B	21	100.0	N N
>OVERSEAS ALASKA	S	30	66.6	Y Y
>OVERSEAS ALICE	N	2	100.0	N N
>OVERSEAS ARCTIC	O	12	0.0	Y Y
>OVERSEAS CHICAGO	F	78	0.0	Y Y
>OVERSEAS HARRIET	U	43	51.1	Y Y
>OVERSEAS JOYCE	K	95	43.1	Y Y
>OVERSEAS NEW ORLEANS	U	46	93.4	Y Y
>OVERSEAS OHIO	F	6	50.0	Y Y
>OVERSEAS WASHINGTON	U	22	45.4	Y Y
>PACASIA	S	4	100.0	N N
>PACDUKE	S	25	100.0	N N
>PACIFIC EMERALD	S	28	100.0	N N
>PACMERCHANT	S	24	100.0	N N
>PACPRINCE	S	11	100.0	N N
>PACPRINCESS	U	11	100.0	N N
>PACSUN	S	11	100.0	N N
>PALMGRACHT	B	2	100.0	N N
>PAPAGO	S	79	78.4	Y Y
>PARIS SENATOR	N	18	100.0	N N
>PATRIOT	U	38	100.0	N N
>PATRIOT STATE	M	143	31.4	Y Y
>PAUL BUCK	U	15	73.3	Y Y
>PAUL H. TOWNSEND	C	19	10.5	Y Y
>PAUL R. TREGURTHA	C	46	0.0	Y Y
>PETER W. ANDERSON	N	11	100.0	N N
>PETROBULK RACER	M	96	0.0	Y Y
>PFC DEWAYNE T. WILLIAM	N	37	100.0	N N
>PFC JAMES ANDERSON JR	J	17	52.9	Y Y
>PFC WILLIAM B. BAUGH	N	4	100.0	N N
>PHAROS	N	48	100.0	N N
>PHILIP R. CLARKE	G	7	57.1	Y Y
>PHOENIX DIAMOND	N	97	100.0	N N
>PISCES PIONEER	S	64	100.0	N N
>PISCES PLANTER	U	113	100.0	N N
>PLATTE	O	10	90.0	Y Y
>POLYNESIA	T	97	87.6	Y Y
>POOLGRACHT	B	62	100.0	N N
>POROS	O	43	93.0	Y Y
>POTOMAC TRADER	U	31	100.0	N N
>PRESIDENT ADAMS	F	91	90.1	Y Y
>PRESIDENT ARTHUR	F	128	14.0	Y Y
>PRESIDENT BUCHANAN	F	24	100.0	N N
>PRESIDENT EISENHOWER	T	126	0.0	Y Y
>PRESIDENT F. ROOSEVELT	T	146	88.3	Y Y
>PRESIDENT GARFIELD	F	16	100.0	N N
>PRESIDENT GRANT	S	63	65.0	Y Y
>PRESIDENT HARRISON	S	53	100.0	N N
>PRESIDENT HARDING	F	127	51.1	Y Y
>PRESIDENT HOOVER	S	73	19.1	Y Y
>PRESIDENT JACKSON	S	103	50.4	Y Y
>PRESIDENT JEFFERSON	S	48	33.3	Y Y

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PMO		No. Obs.	% via Forms Radio	Y-yes; N-no J	F(month)
>PRESIDENT KENNEDY	F	129	89.1	Y	Y
>PRESIDENT LINCOLN	F	128	76.5	Y	Y
>PRESIDENT MONROE	F	140	84.2	Y	Y
>PRESIDENT POLK	F	125	46.4	Y	Y
>PRESIDENT TRUMAN	F	63	53.9	Y	Y
>PRESIDENT TYLER	S	115	72.1	Y	Y
>PRESIDENT WASHINGTON	F	146	72.6	Y	Y
>PRINCE OF OCEAN	S	148	0.0	Y	Y
>PRINCE OF TOKYO 2	S	70	72.8	Y	Y
>PRINCE OF TOKYO	S	56	51.7	Y	Y
>PRINCE WILLIAM SOUND	T	117	27.3	Y	Y
>PROJECT ORIENT	B	105	100.0	N	N
>PROSPERO	K	41	100.0	N	N
>PUERTO CORTES	K	33	100.0	N	N
>PVT FRANKLIN J. PHILLI	N	32	59.3	Y	Y
>PYTCHLEY	N	133	100.0	N	N
>QUALITY OF LIFE	K	17	76.4	Y	Y
>QUEEN ELIZABETH 2	Y	78	100.0	N	N
>QUEENSLAND STAR	U	119	100.0	N	N
>R. HAL DEAN	T	9	100.0	N	N
>R.J. PFEIFFER	T	158	62.6	Y	Y
>RAINBOW WARRIOR	F	21	100.0	N	N
>RANI PADMINI	N	16	100.0	N	N
>RECIFE	U	47	68.0	Y	Y
>REGAL EMPRESS	Y	57	40.3	Y	Y
>REGAL PRINCESS	M	40	100.0	N	N
>REPULSE BAY	U	97	100.0	N	N
>RESERVE	C	16	68.7	Y	Y
>RESOLUTE	N	86	29.0	Y	Y
>RHINE FOREST	O	124	60.4	Y	Y
>RICHARD G MATTIESEN	K	77	85.7	Y	Y
>ROBERT E. LEE	O	59	28.8	Y	Y
>ROGER BLOUGH	G	23	100.0	N	N
>ROSINA TOPIC	S	5	20.0	Y	Y
>ROSITA	M	54	83.3	Y	Y
>ROTTERDAM	Y	7	100.0	N	N
>ROVER	U	96	29.1	Y	Y
>ROWANBANK	N	50	100.0	N	N
>ROYAL PRINCESS	T	58	100.0	N	N
>RYNDAM	M	22	100.0	N	N
>S.T. CRAPO	C	25	4.0	Y	Y
>SALINAS	S	10	100.0	N	N
>SALOME	J	103	35.9	Y	Y
>SAMUAL GINN	F	101	66.3	Y	Y
>SAMUEL H. ARMACOST	F	55	32.7	Y	Y
>SAMUEL L. COBB	F	51	86.2	Y	Y
>SAMUEL RISLEY	N	81	100.0	N	N
>SAN ISIDRO	N	92	100.0	N	N
>SAN LORENZO	B	25	100.0	N	N
>SAN MARCOS	K	178	100.0	N	N
>SAN PEDRO	N	16	100.0	N	N
>SAN VINCENTE	N	44	100.0	N	N
>SANTA MONICA	N	87	100.0	N	N
>SANTA PAULA	O	123	92.6	Y	Y
>SANTORIN 2	S	237	24.4	Y	Y
>SAPAI	U	44	100.0	N	N
>SARAJEVO EXPRESS	B	25	100.0	N	N
>SATURN DIAMOND	K	58	100.0	N	N
>SAVANNAH	N	5	100.0	N	N
>SEA COMMERCE	M	127	26.7	Y	Y
>SEA FOX	K	53	86.7	Y	Y
>SEA ISLE CITY	U	18	100.0	N	N
>SEA LION	K	129	100.0	N	N
>SEA PRINCESS	O	15	100.0	N	N
>SEA TRADE	N	93	100.0	N	N
>SEA WOLF	K	184	96.1	Y	Y
>SEA-LAND SHINING STAR	U	46	60.8	Y	Y
>SEABOARD OCEAN	M	66	95.4	Y	Y
>SEABOARD SUN	K	43	95.3	Y	Y
>SEABOARD UNIVERSE	M	82	63.4	Y	Y
>SEALAND ANCHORAGE	S	96	51.0	Y	Y
>SEALAND ATLANTIC	U	86	94.1	Y	Y
>SEALAND CHALLENGER	J	118	27.1	Y	Y
>SEALAND CONSUMER	T	163	78.5	Y	Y
>SEALAND COSTA RICA	O	114	92.9	Y	Y
>SEALAND CRUSADER	K	77	83.1	Y	Y

PMO		No. Obs.	% via Forms Radio	Y-yes; N-no J	F(month)
>SEALAND DEFENDER	F	126	69.0	Y	Y
>SEALAND DEVELOPER	S	77	33.7	Y	Y
>SEALAND DISCOVERY	K	74	68.9	Y	Y
>SEALAND ENDURANCE	S	42	54.7	Y	Y
>SEALAND ENTERPRISE	F	177	93.2	Y	Y
>SEALAND EXPEDITION	K	56	46.4	Y	Y
>SEALAND EXPLORER	T	110	70.0	Y	Y
>SEALAND EXPRESS	S	126	84.9	Y	Y
>SEALAND HAWAII	F	146	93.1	Y	Y
>SEALAND INDEPENDENCE	S	63	76.1	Y	Y
>SEALAND INNOVATOR	F	88	85.2	Y	Y
>SEALAND INTEGRITY	U	263	93.9	Y	Y
>SEALAND KODIAK	S	3	100.0	N	N
>SEALAND LIBERATOR	F	82	48.7	Y	Y
>SEALAND MARINER	S	127	55.9	Y	Y
>SEALAND NAVIGATOR	T	153	98.0	Y	Y
>SEALAND PACIFIC	T	154	96.1	Y	Y
>SEALAND PATRIOT	F	71	47.8	Y	Y
>SEALAND PERFORMANCE	N	136	46.3	Y	Y
>SEALAND PRODUCER	T	144	64.5	Y	Y
>SEALAND QUALITY	K	100	56.0	Y	Y
>SEALAND RELIANCE	T	96	78.1	Y	Y
>SEALAND SPIRIT	F	157	44.5	Y	Y
>SEALAND TACOMA	S	87	55.1	Y	Y
>SEALAND TRADER	F	117	89.7	Y	Y
>SEALAND VOYAGER	S	56	80.3	Y	Y
>SEARIVER BATON ROUGE	F	43	83.7	Y	Y
>SEARIVER BENICIA	T	24	62.5	Y	Y
>SEARIVER CHARLESTOWN	U	13	100.0	N	N
>SEARIVER LONG BEACH	T	24	29.1	Y	Y
>SEARIVER PHILADELPHIA	F	21	57.1	Y	Y
>SEARIVER SAN FRANCISCO	F	26	92.3	Y	Y
>SEAWARD JOHNSON	M	95	7.3	Y	Y
>SEDCO/BP 471	N	217	34.5	Y	Y
>SENATOR	M	48	100.0	N	N
>SENSATION	M	70	91.4	Y	Y
>SERAFIN TOPIC	B	7	100.0	N	N
>SEVEN OCEAN	S	25	72.0	Y	Y
>SGT. METEJ KOCAK	N	26	0.0	Y	Y
>SHELDON LYKES	U	117	41.8	Y	Y
>SHELLY BAY	M	92	91.3	Y	Y
>SHIRAOI MARU	S	90	92.2	Y	Y
>SIDNEY STAR	U	127	100.0	N	N
>SINCERE GEMINI	S	14	100.0	N	N
>SKAUBRYN	S	99	100.0	N	N
>SKAUGRAN	S	91	96.7	Y	Y
>SKOGAPOSS	N	124	100.0	N	N
>SKY PRINCESS	M	76	52.6	Y	Y
>SN	U	88	100.0	N	N
>SOKOLICA	B	38	100.0	N	N
>SOL DO BRASIL	B	51	23.5	Y	Y
>SOLAR WING	K	64	100.0	N	N
>SONORA	U	116	0.0	Y	Y
>SOUTHERN LION	T	83	100.0	N	N
>SOUTHERN PRINCESS	J	151	0.0	Y	Y
>SPRING TIGER	B	3	100.0	N	N
>ST BLAIZE	N	33	100.0	N	N
>ST. LUCIA	N	7	100.0	N	N
>STAFFORDSHIRE	U	3	100.0	N	N
>STAR DAVANGER	S	4	100.0	N	N
>STAR DOVER	S	15	100.0	N	N
>STAR EAGLE	U	30	63.3	Y	Y
>STAR EVVIVA	K	39	100.0	N	N
>STAR FLORIDA	U	4	75.0	Y	Y
>STAR FRASER	U	62	100.0	N	N
>STAR GEIRANGER	T	12	100.0	N	N
>STAR SKARVEN	M	27	70.3	Y	Y
>STAR SKOGANGER	U	58	48.2	Y	Y
>STAR STRONEN	U	63	65.0	Y	Y
>STARSHIP MAJESTIC	B	2	100.0	N	N
>STATE OF GUIARAT	U	28	100.0	N	N
>STELLA LYKES	U	25	92.0	Y	Y
>STELLAR BENY	S	52	94.2	Y	Y
>STELLAR VENUS	S	20	100.0	N	N
>STOLT CONDOR	J	4	100.0	N	N
>STONEWALL JACKSON	O	13	100.0	N	N

January and February 1995

PMO		No. Obs.	% via Radio	Forms J	Y-yes; N-no F(month)
>STRONG VIRGINIAN	F	31	61.2	Y	Y
>SUE LYKES	U	20	100.0	N	N
>SUGAR ISLANDER	U	5	100.0	N	N
>SUN VIKING	M	6	100.0	N	N
>SUNBELT DIXIE	B	31	100.0	N	N
>SYNNOVE KNUSTEN	K	45	0.0	Y	Y
>TADEUSZ OCIOSZYNSKI	U	2	100.0	N	N
>TAI CHUNG	S	55	94.5	Y	Y
>TAI HE	T	107	100.0	N	N
>TAI SHING	S	40	72.5	Y	Y
>TALLAHASSEE BAY	U	2	100.0	N	N
>TAMAMONTA	U	51	100.0	N	N
>TAMATHAI	U	1	100.0	N	N
>TAMPA	T	33	27.2	Y	Y
>TAMPA BAY	U	79	63.2	Y	Y
>TEAL ARROW	J	54	94.4	Y	Y
>TEXAS SUN	U	5	100.0	N	N
>THOMAS G. THOMPSON	S	155	0.0	Y	Y
>THOMPSON LYKES	U	83	42.1	Y	Y
>THOMPSON PASS	S	39	0.0	Y	Y
>TILLIE LYKES	U	64	59.3	Y	Y
>TOKYO HIGHWAY	T	4	100.0	N	N
>TOKYO SENATOR	T	2	100.0	N	N
>TOLUCA	T	106	61.3	Y	Y
>TONSINA	U	18	100.0	N	N
>TORM FREYA	N	39	71.7	Y	Y
>TOWER BRIDGE	S	25	100.0	N	N
>TRANSWORLD BRIDGE	S	111	96.3	Y	Y
>TRINITY	U	66	74.2	Y	Y
>TROPIC DAY	M	65	49.2	Y	Y
>TROPIC FLYER	M	42	38.0	Y	Y
>TROPIC JADE	M	25	0.0	Y	Y
>TROPIC KEY	M	11	0.0	Y	Y
>TROPIC LURE	M	73	36.9	Y	Y
>TROPIC MIST	M	69	0.0	Y	Y
>TROPIC OPAL	M	47	0.0	Y	Y
>TROPIC PALM	M	52	0.0	Y	Y
>TROPIC SUN	M	170	98.2	Y	Y
>TROPIC TIDE	M	81	59.2	Y	Y
>TULSIDAS	N	11	100.0	N	N
>TYSON LYKES	U	68	30.8	Y	Y
>UCHOA	J	2	100.0	N	N
>ULAN BATOR	U	5	100.0	N	N
>ULLSWATER	N	134	100.0	N	N
>ULTRAMAX	U	21	0.0	Y	Y
>ULTRASEA	O	25	4.0	Y	Y
>USCGC ACTIVE WMEC 618	S	50	100.0	N	N
>USCGC ACUSHNET WMEC 16	F	105	100.0	N	N
>USCGC ALERT (WMEC 630)	S	30	100.0	N	N
>USCGC BASSWOOD (WLB 38	S	19	100.0	N	N
>USCGC BEAR (WEMC 901)	N	68	47.0	Y	Y
>USCGC BRAMBLE (WLB 392	C	3	100.0	N	N
>USCGC CAMPBELL	N	35	60.0	Y	Y
>USCGC CHASE (WHEC 718)	T	1	100.0	N	N
>USCGC COURAGEOUS	N	18	100.0	N	N
>USCGC DALLAS (WHEC 716	Y	1	100.0	N	N
>USCGC DECISIVE WMEC 62	M	27	96.2	Y	Y
>USCGC DEPENDABLE	U	29	100.0	N	N
>USCGC DILIGENCE WMEC 6	N	1	100.0	N	N
>USCGC ESCANABA	N	1	100.0	N	N
>USCGC FIREBUSH WLB 393	A	8	100.0	N	N
>USCGC FORWARD	N	21	100.0	N	N
>USCGC GALLATIN	Y	184	63.5	Y	Y
>USCGC HARRIET LANE	N	12	100.0	N	N
>USCGC IRONWOOD (WLB 29	A	6	100.0	N	N
>USCGC JARVIS (WHEC 725	S	4	100.0	N	N
>USCGC KATMAI BAY	G	1	100.0	N	N
>USCGC LEGARE	N	21	100.0	N	N
>USCGC MACKINAW	G	13	61.5	Y	Y
>USCGC MALLOW (WLB 396)	S	8	100.0	N	N
>USCGC MELLON (WHEC 717	S	154	51.2	Y	Y
>USCGC MIDGETT (WHEC 72	S	74	94.5	Y	Y
>USCGC MOHAWK WMEC 913	K	2	100.0	N	N
>USCGC MORGENTHAU	F	18	100.0	N	N
>USCGC MUNRO	Y	57	96.4	Y	Y
>USCGC NORTHLAND WMEC 9	N	13	76.9	Y	Y
>USCGC POLAR STAR (WAGB	S	252	100.0	N	N
>USCGC RELIANCE WMEC 61	M	15	100.0	N	N
>USCGC RUSH	F	127	100.0	N	N

PMO		No. Obs.	% via Radio	Forms J	Y-yes; N-no F(month)
>USCGC POLAR SEA__(WAGB	S	275	48.3	Y	Y
>USCGC SEDGE (WLB 402)	S	11	100.0	N	N
>USCGC SENECA	N	30	100.0	N	N
>USCGC SHERMAN	F	133	74.4	Y	Y
>USCGC SPENCER	N	99	8.0	Y	Y
>USCGC STEADFAST (WMEC	S	95	83.1	Y	Y
>USCGC STORIS (WMEC 38)	S	158	82.2	Y	Y
>USCGC SUNDEW (WLB 404)	G	2	100.0	N	N
>USCGC TAHOMA	N	27	100.0	N	N
>USCGC TAMPA WMEC 902	N	24	0.0	Y	Y
>USCGC THETIS	K	24	0.0	Y	Y
>USCGC VALIANT (WMEC 62	M	4	25.0	Y	Y
>USCGC VIGILANT WMEC 61	M	1	100.0	N	N
>USCGC YOCONA (WMEC 168	S	7	100.0	N	N
>USNS APACHE (T-ATF 172	N	34	67.6	Y	Y
>USNS CATAWBA T-ATF 168	S	24	100.0	N	N
>USNS CONCORD	N	42	0.0	Y	Y
>USNS DENEBOLA	J	1	100.0	N	N
>USNS GUADALUPE	O	3	100.0	N	N
>USNS GUS W. DARNELL	U	15	100.0	N	N
>USNS HAYES	K	24	0.0	Y	Y
>USNS HENRY J. KAISER	N	33	51.5	Y	Y
>USNS JOHN MCDONNELL (T	O	173	84.9	Y	Y
>USNS LEROY GRUMMAN	N	63	0.0	Y	Y
>USNS LITTLEHALES (T-AG	O	48	54.1	Y	Y
>USNS MARS	F	47	100.0	N	N
>USNS MOHAWK (T-ATF 170	N	52	0.0	Y	Y
>USNS NARRAGANSETT	T	42	45.2	Y	Y
>USNS NAVAJO_(TATF-169)	T	51	100.0	N	N
>USNS OBSERVATION ISLAN	F	93	100.0	N	N
>USNS PATHFINDER T-AGS	O	103	16.5	Y	Y
>USNS POWHATAN TATF 166	N	31	100.0	N	N
>USNS SAN DIEGO	N	19	100.0	N	N
>USNS SEALIFT INDIAN OC	U	56	100.0	N	N
>USNS SEALIFT CHINA SEA	U	35	100.0	N	N
>USNS SEALIFT MEDITERRA	U	30	100.0	N	N
>USNS SEALIFT CARIBBEAN	U	36	88.8	Y	Y
>USNS SEALIFT ATLANTIC	U	123	91.0	Y	Y
>USNS SEALIFT ARCTIC	U	20	100.0	N	N
>USNS SEALIFT ANTARCTIC	U	4	100.0	N	N
>USNS SILAS BENT T-AGS	F	45	8.8	Y	Y
>USNS SIRIUS (T-AFS 8)	N	132	0.0	Y	Y
>USNS VANGUARD TAG 194	J	31	100.0	N	N
>USNS WALTER S. DIEHL	F	52	0.0	Y	Y
>USNS WILKES T-AGS-33	N	80	90.0	Y	Y
>USNS YUKON (T-AO 202)	O	10	100.0	N	N
>VENUS DIAMOND	U	39	100.0	N	N
>VERA ACORDE	S	2	100.0	N	N
>VINA DEL MAR	U	57	100.0	N	N
>VINE	N	141	100.0	N	N
>VIRGINIA	S	117	35.0	Y	Y
>VISAYAS VICTORY	B	116	0.0	Y	Y
>VIVA	N	142	30.9	Y	Y
>VOROSMARTY	B	12	0.0	Y	Y
>WALTER J. MCCARTHY	C	2	100.0	N	N
>WASHINGTON HIGHWAY	S	134	100.0	N	N
>WEST MOOR	M	163	100.0	N	N
>WESTERDAM	M	89	100.0	N	N
>WESTERN LION	T	200	96.0	Y	Y
>WESTWOOD ANETTE	S	101	91.0	Y	Y
>WESTWOOD BELINDA	S	28	85.7	Y	Y
>WESTWOOD CLEO	S	92	75.0	Y	Y
>WESTWOOD JAGO	S	93	67.7	Y	Y
>WESTWOOD MARIANNE	S	94	28.7	Y	Y
>WILFRED SYKES	G	2	100.0	N	N
>WILLIAM E. MUSSMAN	S	14	100.0	N	N
>YOUNG SPROUT	S	33	42.4	Y	Y
>YUCATAN	U	73	91.7	Y	Y
>ZAGREB EXPRESS	N	18	100.0	N	N
>ZETLAND	N	115	100.0	N	N
>ZIM AMERICA	J	11	100.0	N	N
>ZIM CANADA	N	60	100.0	N	N
>ZIM HONGKONG	J	7	100.0	N	N
>ZIM HOUSTON	J	4	100.0	N	N
>ZIM IBERIA	T	88	100.0	N	N
>ZIM JAPAN	B	60	100.0	N	N
>ZIM KEELUNG	J	49	100.0	N	N

January, February and March 1995

Wave observations are taken each hour during a 20–minute averaging period, with a sample taken every 0.67 seconds. The significant wave height is defined as the average height of the highest one–third of the waves during the average period each hour. The maximum significant wave height is the highest of those values for that month. At most stations, air temperature, water temperature, wind speed and direction are sampled once per second during an 8.0–minute averaging period each hour (moored buoys) and a 2.0–minute averaging period for fixed stations (C–MAN). Contact NDBC Data Systems Division, Bldg 1100, SSC, Mississippi 39529 or phone (601) 688–1720 for more details.

BUOY	LAT	LONG	OBS	MEAN AIR TP (C)	MEAN SEA TP (C)	MEAN SIG WAVE HT (M)	MAX SIG WAVE HT (M)	MAX SIG WAVE HT (DA/HR)	SCALAR MEAN WIND SPEED (KNOTS)	PREV WIND (DIR)	MAX WIND (KTS)	MAX WIND (DA/HR)	MEAN PRESS (MB)
JANUARY	1995												
32302	18.0S	085.1W	0736	21.0	21.4	1.9	3.1	28/13	11.6	SE	17.5	19/08	1014.1
41001	34.7N	072.6W	0744	16.0	21.0	2.7	6.3	21/01	17.4	NW	37.3	07/15	1015.9
41002	32.3N	075.2W	0495	18.0	21.4	2.3	6.1	15/13	16.1	W	33.0	07/12	1017.7
41004	32.5N	079.1W	0741	14.2	20.4	1.6	5.7	15/02	14.5	W	34.8	07/08	
41006	29.3N	077.3W	0738	19.8	22.6	2.2	5.7	15/06	15.4	NW	31.9	24/05	1017.5
41009	28.5N	080.2W	1483	18.0	22.0	1.3	4.3	14/07	14.5	NW	31.9	14/04	1018.4
41010	28.9N	078.5W	1484	19.8	23.8	1.9	4.9	15/04	14.2	NW	31.3	14/14	1017.3
41016	24.6N	076.5W	0738	22.9	25.4	0.6	2.7	14/16	12.3	N	25.6	14/01	1019.1
41018	15.0N	075.0W	0739	26.7	27.2	1.9	3.0	28/01	17.1	E	23.7	07/04	1013.7
42001	25.9N	089.7W	0738	20.5	23.0	1.4	4.8	15/06	14.6	SE	30.9	13/18	1018.2
42002	25.9N	093.6W	0737	20.8	23.2	1.6	3.8	04/20	15.6	SE	28.0	04/18	1017.7
42003	25.9N	085.9W	0577	21.0	25.9	1.1	2.7	23/23	10.5	NW	29.7	23/16	1018.5
42007	30.1N	088.8W	0742	12.2	14.5				13.4	NW	29.7	23/11	1018.8
42020	27.0N	096.5W	0742	18.9		1.5	3.8	23/09	14.4	N	32.4	19/01	1018.0
42025	24.9N	080.5W	0469	20.5	23.5	0.6	2.8	14/05					
42035	29.3N	094.4W	0738	13.3	14.9	0.9	2.6	06/03	12.5	N	29.1	19/03	1018.6
42036	28.5N	084.5W	0742	17.4	20.2	1.3	3.6	15/14	12.5	NW	28.8	06/21	1019.3
42037	24.5N	081.4W	0737	21.1	23.5	0.8	3.3	14/08	11.0	N	22.5	14/06	1018.4
44004	38.5N	070.7W	0742	11.3	16.7	2.8	8.5	07/13	16.5	NW	38.5	07/12	1015.5
44005	42.9N	069.0W	0740	2.6	6.1	2.2	5.6	07/15	16.4	N	35.6	07/14	1014.2
44006	36.3N	075.5W	0742	8.0	9.9	1.1	2.3	05/14	14.1	N	30.7	07/07	1017.1
44007	43.5N	070.2W	0731	-0.4	5.2	1.1	3.3	21/01	12.8	N	29.0	06/00	1013.5
44008	40.5N	069.4W	0739	6.4	8.3	2.5	7.9	07/18					1014.9
44009	38.5N	074.7W	0739	5.6	7.9	1.4	3.2	15/20	15.1	NW	29.7	02/11	1016.6
44010	36.0N	075.0W	0733	10.5	14.2	2.0	5.7	15/14	15.3	NW	35.4	07/07	1016.4
44011	41.1N	066.6W	0741	5.2	7.1	2.7	7.8	07/20					1014.1
44013	42.4N	070.7W	0736	2.0		1.0	3.6	21/00	13.7	W	27.4	20/20	1014.3
44014	36.6N	074.8W	0738	9.1									1016.7
44025	40.3N	073.2W	0739	4.3	7.0	1.6	4.0	07/11	15.6	W	29.1	07/07	1015.6
44028	41.4N	071.1W	0738	2.9	5.2	1.2	4.2	07/12	16.6	SW	36.3	07/10	1014.9
46001	56.3N	148.2W	0734		4.1	3.1	7.4	04/10	14.8	E	30.5	04/03	998.2
46002	42.5N	130.3W	0739	11.1	11.3	4.3	7.4	22/09	18.4	SE	38.5	06/23	1000.1
46003	51.9N	155.9W	0740	3.5	4.0	3.5	8.7	17/01	16.7	NE	31.1	01/15	993.1
46005	46.1N	131.0W	0740	9.5	9.3	3.9	7.7	19/07	16.7	E	34.4	10/05	999.7
46006	40.9N	137.5W	0738	11.3	12.1	4.6	8.4	02/23					997.5
46011	34.9N	120.9W	0737	12.9	13.4	3.2	7.0	08/06	12.9	SE	35.6	07/07	1015.9
46013	38.2N	123.3W	0738	11.7	12.2	3.5	7.3	22/21	15.9	SE	37.5	07/03	1013.5
46014	39.2N	124.0W	0734	11.7	11.6	3.6	7.9	23/03	16.8	SE	37.3	09/14	1011.8
46022	40.8N	124.5W	0731	11.7	11.4	3.5	8.5	22/20	17.9	S	46.0	09/19	1009.8
46023	34.3N	120.7W	0737	13.1	13.5	3.1	6.6	23/09					1016.3
46025	33.8N	119.1W	0505	13.7	14.1	1.9	5.6	26/13	10.3	NW	28.4	16/03	1017.7
46026	37.8N	122.8W	0736	12.0	11.6	3.0	6.3	23/00	14.7	S	38.7	07/04	1013.6
46028	35.8N	121.9W	0082	12.7		3.4	4.7	03/05	14.6	SE	29.0	03/04	1015.6
46029	46.2N	124.2W	0193	8.0	8.0	2.5	7.0	08/16					1007.3
46030	40.4N	124.5W	0738	11.4	11.3	3.4	7.7	09/21	19.5	SE	42.7	09/14	1009.4
46035	57.0N	177.7W	0285	-5.5	2.1	3.1	8.0	15/23	19.7	N	35.9	29/13	1013.4
46041	47.4N	124.5W	0735	8.5	8.7	2.6	5.7	29/17	13.9	SE	30.7	14/21	1006.9
46042	36.8N	122.4W	0738	12.4	12.6	3.3	7.4	22/21	14.2	SE	36.7	07/05	1014.4
46045	33.8N	118.5W	0736	13.2	14.1	1.5	3.6	05/12					1017.5
46050	44.6N	124.5W	0738	9.8		3.2	6.0	10/02					1006.0
46053	34.2N	119.9W	0742	13.4	14.0	2.0	4.7	23/07	12.9	E	41.8	04/20	1018.0
46054	34.3N	120.5W	0742	13.3	13.7	3.0	6.6	23/01	14.0	SE	34.6	04/15	1017.2
46059	38.0N	130.0W	0729	13.3	13.4	4.5	9.8	22/06	17.3	SW	34.6	07/05	1005.8
51001	23.4N	162.3W	0739	22.9	24.4	3.5	7.2	31/09	12.7	E	29.3	30/02	1016.3
51002	17.2N	157.8W	0738	23.7	24.2	2.8	5.3	31/13	13.3	E	23.7	15/20	1015.8
51003	19.1N	160.8W	0484	24.1	24.7	2.5	4.9	31/21	12.5	E	23.1	13/05	1015.3
51004	17.4N	152.5W	0737		24.1	2.8	5.7	10/19	13.2	NE	23.1	15/10	1017.3
51026	21.4N	156.9W	0144	23.7	23.4	2.3	4.5	31/18	15.1	SW	22.7	27/21	1012.5
51027	20.5N	157.1W	0737	23.1	24.1	1.8	3.3	31/06	10.1	E	25.6	06/01	1016.4
91222	18.1N	145.8E	0626	24.9					5.8	NE	14.8	04/05	1014.3
91251	11.4N	162.4E	0469	27.0					16.7	NE	25.9	29/08	1010.3

January, February and March 1995

	BUOY	LAT	LONG	OBS	MEAN AIR TP (C)	MEAN SEA TP (C)	MEAN SIG WAVE HT (M)	MAX SIG WAVE HT (M)	MAX SIG WAVE HT (DA/HR)	SCALAR MEAN WIND SPEED (KNOTS)	PREV WIND (DIR)	MAX WIND (KTS)	MAX WIND (DA/HR)	MEAN PRESS (MB)
	91328	8.6N	149.7E	0720	27.5					9.5	NE	21.5	14/23	1011.2
	91338	5.3N	153.7E	0399	27.5					5.8	NE	17.5	04/16	1008.7
	91352	6.2N	160.7E	0710	27.5					11.2	NE	22.1	03/20	1010.4
	91355	5.4N	163.0E	0738	27.3					8.2	NE	19.9	25/13	1008.1
	91377	6.1N	172.1E	0486	27.7					9.1	NE	27.0	31/04	1010.7
	ABAN6	44.3N	075.9W	0736	-3.3	3.7				4.5	N	19.1	15/15	
	ALSN6	40.5N	073.8W	0741	3.1	6.7	1.0	2.7	20/14	17.6	W	38.0	16/00	1016.1
	BURL1	28.9N	089.4W	0738	13.8					14.8	NE	37.2	13/13	1018.5
	CARO3	43.3N	124.4W	0736	9.8					12.1	SE	39.4	14/14	1007.3
	CHLV2	36.9N	075.7W	0740	6.7					17.1	N	41.1	07/04	1017.4
	CLKN7	34.6N	076.5W	0743	9.6					12.7	N	33.5	15/10	1018.3
	CSBF1	29.7N	085.4W	0738	12.9					8.2	NW	27.9	20/09	1019.4
	DBLN6	42.5N	079.4W	0742						14.2	SW	41.1	04/17	1014.6
	DESW1	47.7N	124.5W	0739	7.9					14.5	SE	43.3	14/23	1007.1
	DISW3	47.1N	090.7W	0739	-6.4					14.1	SW	36.5	05/09	1012.7
	DPIA1	30.3N	088.1W	0739	11.9					11.5	NW	30.0	06/18	1019.4
	DRYF1	24.6N	082.9W	0740	20.9	22.3				12.4	NE	27.2	30/17	1018.5
	DSLN7	35.2N	075.3W	0739	11.6					20.1	N	53.2	15/17	1017.5
	FBIS1	32.7N	079.9W	0743	10.1					7.8	W	26.4	07/07	1018.1
	FFIA2	57.3N	133.6W	0737	3.0					11.2	N	33.3	29/00	1006.2
	FPSN7	33.5N	077.6W	0591	12.8					17.4	N	49.9	07/04	1017.7
	FWYF1	25.6N	080.1W	0742	20.3	22.8				13.8	NW	35.2	14/02	1018.9
	GDIL1	29.3N	090.0W	0740	13.2	14.9				12.0	NW	31.0	23/12	1019.4
	GLLN6	43.9N	076.5W	0741	-1.3					15.5	NW	40.3	06/02	1014.0
	IOSN3	43.0N	070.6W	0740	0.4					15.7	W	41.1	20/21	1014.1
	LKWF1	26.6N	080.0W	0641	18.5	22.9				10.5	NW	35.1	15/00	1020.0
	LONF1	24.9N	080.9W	0737	20.2	20.8				10.8	N	26.2	14/02	1018.7
	MDRM1	44.0N	068.1W	0739						18.6	NW	44.8	02/21	1013.4
	MISM1	43.8N	068.9W	0741	0.1					18.7	NW	45.3	07/14	1013.9
	MLRF1	25.0N	080.4W	0740	20.9	23.7				13.1	N	31.5	05/03	1018.4
	NWPO3	44.6N	124.1W	0737	8.9					13.4	E	39.5	30/13	1007.2
	PILM4	48.2N	088.4W	0739	-7.5					15.9	N	46.5	05/04	1015.8
	PTAC1	39.0N	123.7W	0740	11.5					14.3	SE	39.8	09/15	1012.2
	PTAT2	27.8N	097.1W	0737	14.6	14.6				11.1	N	31.2	18/21	1018.4
	PTGC1	34.6N	120.7W	0737	12.7					13.3	S	53.2	04/17	1015.8
	ROAM4	47.9N	089.3W	0738	-7.6	2.0				18.0	NW	38.1	05/05	1015.8
	SANF1	24.5N	081.9W	0732	20.9	22.9				13.7	NE	26.8	06/16	1018.6
	SAUF1	29.9N	081.3W	0738	12.9	14.9				8.1	NW	24.9	05/22	1019.1
	SBIO1	41.6N	082.8W	0737	-2.1					14.6	SW	31.3	22/05	1016.3
	SGNW3	43.8N	087.7W	0737	-4.9					11.7	W	30.1	19/19	1017.8
	SISW1	48.3N	122.9W	0738	6.8					12.7	SE	40.7	18/20	1009.1
	SMKF1	24.6N	081.1W	0738	20.9	22.9				13.8	N	35.7	14/16	1018.8
	SPGF1	26.7N	079.0W	0741	20.7	23.8				8.4	NE	22.7	20/10	1018.8
	SRST2	29.7N	094.1W	0736	11.8					10.5	NW	26.1	06/04	1018.9
	STDM4	47.2N	087.2W	0740	-4.7					19.1	NW	49.2	05/11	1014.2
	SUPN6	44.5N	075.8W	0622	-2.7	1.6				10.6	NE	39.1	05/21	1014.9
	SVLS1	32.0N	080.7W	0150	10.2	11.9				12.7	S	27.2	28/16	1017.0
	THIN6	44.3N	076.0W	0739	-2.9									
	TPLM2	38.9N	076.4W	0736	3.3	4.6				12.3	NW	28.5	02/16	1017.4
	TTIW1	48.4N	124.7W	0737	7.7					22.2	E	46.0	07/06	1007.2
	VENF1	27.1N	082.5W	0530	15.3	17.0				9.2	NW	24.3	24/02	1018.8
	WPOW1	47.7N	122.4W	0735	7.5					7.7	S	28.5	14/23	1009.8
FEBRUARY 1995														
>	42003	25.9N	085.9W	0660	21.0	24.5	1.1	4.1	04/12	13.5	E	35.0	04/11	1018.6
>	42007	30.1N	088.8W	0667	13.4	15.1				13.5	SW	31.5	07/22	1019.7
>	42020	27.0N	096.5W	0670	20.4		1.3	3.6	08/06	12.9	S	29.7	04/04	1018.3
>	42025	24.9N	080.5W	0662	20.8	22.7	0.5	1.2	28/20					
>	42035	29.3N	094.4W	0658	14.4	14.6	0.8	2.2	07/22	10.1	SE	28.0	07/22	1019.4
>	42036	28.5N	084.5W	0665	16.7	18.0	1.1	4.6	04/13	12.2	NW	30.1	04/10	1020.3
>	42037	24.5N	081.4W	0668	20.6	22.0	0.7	1.7	04/20	9.3	E	25.1	04/17	1019.4
>	44004	38.5N	070.7W	0667	8.0	14.1	2.8	8.9	05/12	17.5	W	21.6	02/08	1014.3
>	44005	42.9N	069.0W	0663	-0.7	3.9	2.2	6.9	05/10	17.4	W	39.2	04/23	1011.8
>	44006	36.3N	075.5W	0652	5.4	7.6	1.2	2.3	19/01	13.8	N	32.1	05/03	1016.9
>	44007	43.5N	070.2W	0094	-1.2	4.3	1.0	6.0	04/22	11.4	SW	17.3	01/02	1004.8
>	44008	40.5N	069.4W	0667	4.0	5.0	2.5	7.9	05/12	13.2	N	25.6	25/02	1013.1
>	44009	38.5N	074.7W	0666	2.3	4.9	1.3	3.1	05/07	17.5	W	34.8	05/06	1015.9
>	44010	36.0N	075.0W	0661	7.7	12.6	1.6	3.8	05/04	15.6	SW	33.2	05/03	1016.2
>	44011	41.1N	066.6W	0671	2.5	5.5	2.9	8.7	05/11	14.6	NE	27.2	25/15	1011.8
>	44013	42.4N	070.7W	0667	-1.3		1.0	5.5	04/22	14.9	W	36.3	04/20	1012.3
>	44014	36.6N	074.8W	0660	6.4		1.7	4.3	05/04	13.5	N	28.4	22/03	1016.3
>	44019	36.4N	075.2W	0327	8.2	8.1	1.4	2.8	22/07	13.0	N	27.0	22/03	1020.1
>	44025	40.3N	073.2W	0662	1.0	4.5	1.5	4.6	04/17	15.7	W	35.0	05/06	1014.3
>	44028	41.4N	071.1W	0662	-0.5	3.4	1.2	3.3	05/01	16.7	W	37.5	05/09	1013.1
>	46001	56.3N	148.2W	0661		4.1	2.9	8.2	05/07	14.9	SE	33.0	05/02	1010.6
>	46002	42.5N	130.3W	0663	10.3	10.8	2.9	5.6	13/06	14.4	S	27.4	13/00	1017.7
>	46005	46.1N	131.0W	0666	8.5	9.2	3.1	6.5	13/00	15.6	S	35.2	17/09	1017.3

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	BUOY	LAT	LONG	OBS	MEAN AIR TP (C)	MEAN SEA TP (C)	MEAN SIG WAVE HT (M)	MAX SIG WAVE HT (M)	MAX SIG WAVE HT (DA/HR)	SCALAR MEAN WIND SPEED (KNOTS)	PREV WIND (DIR)	MAX WIND (KTS)	MAX WIND (DA/HR)	MEAN PRESS (MB)
>	46006	40.9N	137.5W	0670	11.4	11.7	3.4	6.2	02/00					1015.2
>	46011	34.9N	120.9W	0665	13.4	13.6	1.9	4.7	03/02	7.6	NW	19.8	19/00	1017.4
>	46013	38.2N	123.3W	0668	11.7	12.8	1.9	4.2	02/16	7.7	NW	24.1	15/02	1019.6
>	46014	39.2N	124.0W	0667	11.3	12.2	2.0	4.2	02/15	7.2	NW	22.3	14/05	1019.3
>	46022	40.8N	124.5W	0662	11.1	11.8	2.3	4.7	02/14	9.5	N	27.6	17/06	1019.7
>	46023	34.3N	120.7W	0665	13.7	13.8	1.8	4.3	03/08	9.8	NW	24.7	15/02	1016.9
>	46025	33.8N	119.1W	0619	14.7	14.8	1.1	2.9	03/15	5.6	NW	15.7	21/18	1017.4
>	46026	37.8N	122.8W	0668	12.2	12.4	1.6	3.7	02/21	7.3	NW	25.3	03/13	1018.8
>	46027	41.9N	124.4W	0601	10.6	11.2	2.1	4.2	11/11	8.5	SE	28.8	17/08	1018.3
>	46028	35.8N	121.9W	0484	12.7	13.5	1.6	3.0	14/15	8.2	NW	24.9	14/15	1018.2
>	46030	40.4N	124.5W	0666	10.9	11.8	2.1	4.1	02/14	10.5	N	28.0	17/18	1018.6
>	46035	57.0N	177.7W	0667	-3.2	1.6	2.7	8.8	08/17	18.7	NE	34.5	08/12	1008.7
>	46041	47.4N	124.5W	0662	8.3	9.6	2.3	5.7	17/21	7.8	N	20.2	01/02	1017.6
>	46042	36.8N	122.4W	0666	12.3	13.0	1.8	3.7	06/22	8.0	NW	22.2	15/01	1018.4
>	46045	33.8N	118.5W	0666	14.8	15.1	0.9	1.9	03/12	5.1	E	16.9	14/13	1017.3
>	46050	44.6N	124.5W	0666	9.6		2.5	6.2	17/12					1017.2
>	46053	34.2N	119.9W	0672	14.6	14.8	1.1	3.0	07/05	6.3	W	17.9	17/05	1018.2
>	46054	34.3N	120.5W	0670	14.2	14.2	1.8	3.9	03/03	10.3	NW	30.7	18/04	1017.8
>	46059	38.0N	130.0W	0664	12.8	13.7	2.5	5.3	02/10	11.9	S	28.2	07/02	1019.1
>	51001	23.4N	162.3W	0672	21.9	23.7	2.7	6.0	11/05	12.6	SW	30.0	06/12	1013.5
>	51002	17.2N	157.8W	0672	23.7	24.6	2.3	5.3	01/05	8.6	E	19.4	07/04	1014.3
>	51003	19.1N	160.8W	0664	23.6	24.6	2.1	5.0	01/09	7.9	E	20.5	11/02	1014.2
>	51004	17.4N	152.5W	0666	23.7	24.4	2.2	5.1	01/18	8.4	E	20.8	07/13	1015.6
>	51026	21.4N	156.9W	0660	22.3	23.3	2.2	5.5	01/11	10.1	SW	24.7	14/04	1014.6
>	51027	20.5N	157.1W	0665	22.8	23.8	1.5	3.2	07/04	8.6	E	22.0	11/03	1014.3
>	91222	18.1N	145.8E	0614	24.1					5.2	NE	14.0	24/03	1014.2
>	91251	11.4N	162.4E	0651	26.7					14.0	NE	24.0	13/17	1010.7
>	91328	8.6N	149.7E	0668	27.1					8.3	NE	16.3	11/15	1011.6
>	91338	5.3N	153.7E	0493	27.6					5.7	NE	17.5	02/13	1009.6
>	91343	7.6N	155.2E	0665	27.4					12.0	NE	21.3	01/22	1009.4
>	91352	6.2N	160.7E	0648	27.2					11.3	NE	21.4	01/14	1011.1
>	91355	5.4N	163.0E	0665	27.5					9.5	NE	23.3	27/23	1008.6
>	91377	6.1N	172.1E	0664	27.8					9.8	NE	24.1	03/21	1011.5
>	ABAN6	44.3N	075.9W	0662	-7.4	1.1				4.0	N	20.0	16/00	
>	ALSN6	40.5N	073.8W	0665	-0.2	4.7	0.9	3.5	04/16	17.1	W	45.0	04/14	1014.8
>	BURL1	28.9N	089.4W	0668	14.4					13.6	NE	34.3	04/06	1019.5
>	CARO3	43.3N	124.4W	0671	9.9					10.7	S	35.5	17/21	1018.0
>	CHLV2	36.9N	075.7W	0665	3.7					16.3	N	39.5	05/02	1017.0
>	CLKN7	34.6N	076.5W	0667	7.9					12.3	W	33.5	05/03	1018.4
>	CSBF1	29.7N	085.4W	0665	13.5					8.0	E	26.7	05/21	1020.3
>	DBLN6	42.5N	079.4W	0667	-4.6					14.9	SW	43.5	11/21	1014.8
>	DESW1	47.7N	124.5W	0668	8.1					12.9	SE	44.9	15/08	1017.6
>	DISW3	47.1N	090.7W	0667	-8.1					14.0	NW	37.9	10/11	
>	DPIA1	30.3N	088.1W	0667	13.2					11.6	N	31.3	04/11	1020.3
>	DRYF1	24.6N	082.9W	0667	19.8	21.1				9.9	E	29.7	04/18	1019.5
>	DSLN7	35.2N	075.3W	0667	9.2					21.1	N	47.9	05/02	1017.9
>	FBIS1	32.7N	079.9W	0671	9.1					8.9	SW	28.1	04/04	1018.6
>	FFIA2	57.3N	133.6W	0666	2.1					15.1	N	37.6	15/03	1016.7
>	FPSN7	33.5N	077.6W	0514	11.2					17.2	N	38.2	08/05	1019.5
>	FWYF1	25.6N	080.1W	0660	20.2	22.2				13.3	E	34.2	04/21	1019.6
>	GDIL1	29.3N	090.0W	0669	14.8	15.7				11.1	N	32.0	04/09	1020.3
>	GLLN6	43.9N	076.5W	0670	-5.9					16.0	NW	43.6	11/09	1013.4
>	IOSN3	43.0N	070.6W	0662	-2.6					17.2	W	55.8	04/22	1011.4
>	LKWF1	26.6N	080.0W	0580	19.3	22.3				10.0	SE	27.6	04/18	1020.3
>	LONF1	24.9N	080.9W	0628	20.4	20.8				9.8	E	32.6	20/22	1019.3
>	MDRM1	44.0N	068.1W	0670	-3.2					19.3	W	49.7	05/02	1010.5
>	MISM1	43.8N	068.9W	0667	-3.1					19.0	W	58.8	05/00	1011.2
>	MLRF1	25.0N	080.4W	0668	20.7	22.6				11.8	E	34.7	04/20	1019.2
>	NWPO3	44.6N	124.1W	0670	9.3					10.4	E	42.3	17/10	1017.9
>	PILM4	48.2N	088.4W	0667	-9.3					17.1	NW	42.6	10/14	1015.7
>	PTAC1	39.0N	123.7W	0668	11.0					6.8	N	19.5	15/06	1019.1
>	PTAT2	27.8N	097.1W	0669	16.2	16.1				10.7	SE	33.0	08/02	1016.6
>	PTGC1	34.6N	120.7W	0664	13.9					10.1	N	30.6	18/14	1017.1
>	ROAM4	47.9N	089.3W	0666	-9.2									1015.8
>	SANF1	24.5N	081.9W	0662	20.3	21.2				11.2	N	30.6	04/18	1019.2
>	SAUF1	29.9N	081.3W	0667	12.8	14.3				9.6	N	24.1	09/07	1019.9
>	SBIO1	41.6N	082.8W	0654	-4.0					13.2	SW	31.5	05/03	1017.1
>	SGNW3	43.8N	087.7W	0649	-5.5					12.7	W	28.6	10/17	1018.5
>	SISW1	48.3N	122.9W	0666	7.0					10.6	SE	42.0	15/10	1018.5
>	SMKF1	24.6N	081.1W	0664	20.6	21.8				12.8	E	34.8	04/20	1019.8
>	SPGF1	26.7N	079.0W	0670	20.3	23.5				9.5	E	33.6	04/19	1019.5
>	SRST2	29.7N	094.1W	0668	13.7					9.8	SE	24.1	07/20	1019.7
>	STDM4	47.2N	087.2W	0669	-7.2					21.8	NW	45.3	10/20	1014.1
>	SUPN6	44.5N	075.8W	0656	-7.8	0.5				11.4	SW	30.2	09/19	1014.3
>	SVLS1	32.0N	080.7W	0664	10.1	10.9				16.1	W	40.5	04/19	1018.9

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	BUOY	LAT	LONG	OBS	MEAN AIR TP (C)	MEAN SEA TP (C)	MEAN SIG WAVE HT (M)	MAX SIG WAVE HT (M)	MAX SIG WAVE HT (DA/HR)	SCALAR MEAN WIND SPEED (KNOTS)	PREV WIND (DIR)	MAX WIND (KTS)	MAX WIND (DA/HR)	MEAN PRESS (MB)
>	THIN6	44.3N	076.0W	0648	-7.7									
>	TPLM2	38.9N	076.4W	0670	0.4	2.9				11.3	NW	41.0	05/04	1016.9
>	TTIW1	48.4N	124.7W	0668	7.7					16.3	E	48.7	17/17	1017.8
>	VENF1	27.1N	082.5W	0667	16.1	17.0				9.0	NW	33.4	04/12	1020.3
>	WPOW1	47.7N	122.4W	0667	7.6					9.3	S	37.0	17/19	1018.8
MARCH		1995												
>	32302	18.0S	085.1W	0740	21.9	22.5	2.0	3.6	08/07	12.3	SE	19.0	08/08	1013.4
>	41001	34.7N	072.6W	0041	18.9	21.7	3.0	4.3	02/18	22.9	S	28.6	01/21	1014.3
>	41002	32.3N	075.2W	0631	18.2	20.6	1.9	3.7	09/19	13.0	NE	25.6	02/21	1018.0
>	41004	32.5N	079.1W	0740		19.3	1.4	3.3	08/18	13.0	NE	28.0	21/08	
>	41006	29.3N	077.3W	0447	20.0	22.2	2.2	4.1	10/02	15.0	NE	24.9	09/23	1020.0
>	41009	28.5N	080.2W	1487	20.5	21.2	1.3	3.1	09/21	12.9	E	29.3	09/11	1017.4
>	41016	24.6N	076.5W	0735	22.8	24.4	0.6	1.7	08/07	13.0	E	26.1	13/11	1017.7
>	41018	15.0N	075.0W	0369	26.2	26.9	1.2	3.1	07/16	12.6	E	22.2	07/04	1013.0
>	42001	25.9N	089.7W	0735	22.6	24.1	1.3	3.8	08/17	13.8	SE	37.1	08/01	1016.0
>	42002	25.9N	093.6W	0739	21.6	22.6	1.5	3.7	08/05	13.1	SE	34.8	07/21	1015.1
>	42003	25.9N	085.9W	0735	21.9	22.8	1.2	3.4	09/10	12.6	E	33.6	15/00	1015.9
>	42007	30.1N	088.8W	0743	16.6	17.7				14.1	E	32.6	08/05	1017.3
>	42020	27.0N	096.5W	0742	20.3		1.5	4.0	08/09	13.3	SE	35.8	07/18	1015.1
>	42025	24.9N	080.5W	0742	23.2	24.2	0.6	2.0	14/08					
>	42035	29.3N	094.4W	0718	16.5	17.4	1.0	2.5	29/01	12.1	NE	32.1	07/22	1016.2
>	42036	28.5N	084.5W	0736	18.7	18.3	0.9	3.1	09/11	10.7	E	23.3	09/09	1018.2
>	42037	24.5N	081.4W	0737	22.9	24.1	0.8	2.8	14/15	10.1	E	21.6	11/20	1016.7
>	44004	38.5N	070.7W	0740	10.5	14.6	2.2	5.6	09/09					1017.6
>	44005	42.9N	069.0W	0725	2.2	3.6	1.6	3.9	10/03	12.4	N	27.0	10/02	1018.4
>	44006	36.3N	075.5W	0726	8.7	8.1	1.3	3.3	09/10	11.4	N	32.3	09/06	1019.1
>	44007	43.5N	070.2W	0437	3.2	2.9	0.8	1.9	15/19	9.2	N	20.0	21/02	1012.5
>	44008	40.5N	069.4W	0733	16.2	5.1	1.8	4.5	09/13	12.3	N	26.0	05/10	1017.7
>	44009	38.5N	074.7W	0739	5.9	5.5	1.2	3.2	09/07	9.7	NW	32.3	09/06	1019.1
>	44010	36.0N	075.0W	0738	9.9	10.2	1.6	4.2	09/10	12.3	N	31.9	09/07	1018.3
>	44011	41.1N	066.6W	0735	3.7	4.0	2.1	5.0	09/19	13.5	N	27.4	02/21	1016.6
>	44013	42.4N	070.7W	0742	2.7		1.0	2.9	06/04	10.2	N	29.5	10/00	1018.1
>	44014	36.6N	074.8W	0727	8.8		2.0	3.8	09/08	11.8	N	29.9	09/07	1023.3
>	44019	36.4N	075.2W	0740	8.5	8.0	1.9	3.7	02/12	11.5	N	30.7	09/07	1019.3
>	44025	40.3N	073.2W	0736	5.1	5.1	1.1	2.9	09/10	11.4	NW	28.2	09/23	1018.4
>	44028	41.4N	071.1W	0738	3.5	3.4	0.6	2.4	09/08	11.8	N	30.7	10/02	1018.3
>	45002	45.3N	086.4W	0060	-0.3	2.3	0.5	1.3	30/00	10.3	NW	20.2	29/23	1017.0
>	45003	45.3N	082.8W	0034	0.6	2.1	0.7	1.3	31/06	11.2	NW	17.3	31/06	1014.7
>	45007	42.8N	087.1W	0052	3.6	2.4	0.3	1.2	27/09	9.3	E	21.4	27/08	1023.6
>	46001	56.3N	148.2W	0741		3.7	2.9	9.8	21/14	15.8	NW	40.2	21/13	1007.8
>	46002	42.5N	130.3W	0742	9.4	10.5	3.4	9.9	20/07	14.4	S	36.9	20/05	1010.7
>	46005	46.1N	131.0W	0743	7.8	8.9	3.2	9.2	20/05	15.2	S	39.8	19/23	1008.7
>	46006	40.9N	137.5W	0736	10.1	10.9	3.8	11.2	22/15					1011.5
>	46011	34.9N	120.9W	0738	13.6	14.0	2.5	6.7	23/20	12.1	NW	37.3	10/16	1015.5
>	46013	38.2N	123.3W	0740	12.2	13.1	2.6	6.9	23/17	13.0	NW	33.4	09/02	1015.6
>	46014	39.2N	124.0W	0744	11.5	12.4	2.8	7.7	23/19	12.2	SE	34.2	09/14	1014.8
>	46022	40.8N	124.5W	0735	11.1	12.1	2.9	7.7	23/04	14.3	S	42.4	09/06	1014.1
>	46023	34.3N	120.7W	0740	13.7	14.1	2.5	6.6	23/20	14.2	NW	31.1	10/18	1015.3
>	46025	33.8N	119.1W	0663	14.8	15.1	1.3	3.5	11/06	8.0	W	25.6	11/02	1016.0
>	46026	37.8N	122.8W	0738	12.7	12.9	2.2	5.6	23/11	12.4	NW	36.9	09/12	1015.2
>	46027	41.9N	124.4W	0741	10.6	11.4	2.6	6.6	20/21	12.9	S	34.4	22/05	1012.7
>	46028	35.7N	121.9W	0736	13.1	13.7	2.6	7.3	23/19	12.5	NW	31.5	10/06	1016.4
>	46030	40.4N	124.5W	0740	10.8	12.0	2.8	7.3	23/09	14.7	SE	36.7	13/06	1013.4
>	46035	57.0N	177.7W	0735		1.5	2.4	6.2	02/17	15.5	E	35.2	21/12	1019.5
>	46041	47.4N	124.5W	0738	8.2	9.7	2.3	8.9	20/21	6.3	E	12.0	02/05	1011.0
>	46042	36.8N	122.4W	0738	12.9	13.5	2.6	6.7	23/13	12.9	NW	32.3	09/12	1015.7
>	46045	33.8N	118.5W	0739	14.8	15.7	1.1	2.7	11/10					1015.9
>	46050	44.6N	124.5W	0739	9.5		2.7	7.9	20/17					1010.7
>	46053	34.2N	119.9W	0744	14.5	14.8	1.4	3.2	10/21	10.4	W	36.3	10/21	1016.6
>	46054	34.3N	120.5W	0744	13.9	14.1	2.2	5.0	23/16	14.2	NW	35.9	10/19	1016.3
>	46059	38.0N	130.0W	0740	12.0	13.2	3.2	9.3	23/04	14.8	N	35.0	09/10	1014.7
>	51001	23.4N	162.3W	0742	22.2	23.0	2.7	5.3	13/02	13.3	NE	25.3	02/18	1015.6
>	51002	17.2N	157.8W	0744	24.6	25.3	2.7	4.0	05/04	12.1	E	23.5	29/18	1014.6
>	51003	19.1N	160.8W	0742	24.5	25.4	2.5	4.2	04/23	10.8	E	23.0	20/15	1014.8
>	51004	17.4N	152.5W	0735	24.7	25.3	2.4	3.8	21/07	11.7	E	23.4	21/06	1015.9
>	51026	21.4N	156.9W	0738	22.8	23.6	2.2	4.6	04/09	12.9	E	22.2	05/22	1015.9
>	51027	20.5N	157.1W	0739	23.6	24.3	1.5	2.6	21/03	10.8	E	24.7	20/21	1015.0
>	91222	18.1N	145.8E	0668	24.9					6.6	E	17.9	26.04	1013.9
>	91328	8.6N	149.7E	0741	27.5					10.1	NE	17.1	18/11	1011.1
>	91338	5.3N	153.7E	0573	27.8					6.5	NE	23.3	13/07	1008.9
>	91343	7.6N	155.2E	0743	27.7					15.1	NE	24.2	20/02	1009.0
>	91352	6.2N	160.7E	0727	27.5					12.9	NE	23.2	24/01	1010.6
>	91355	5.4N	163.0E	0739	27.5					9.8	NE	22.1	24/20	1008.1
>	91377	6.1N	172.1E	0735	28.0					9.8	NE	22.3	29/01	1011.0
>	ABAN6	44.3N	075.9W	0709	1.1	1.0				3.6	S	24.3	08/04	1013.8
>	ALSN6	40.5N	073.8W	0735	5.3	5.5				14.2	NW	35.7	09/11	1019.0

NDBC Station Data

January, February and March 1995

	BUOY	LAT	LONG	OBS	MEAN AIR TP (C)	MEAN SEA TP (C)	MEAN SIG WAVE HT (M)	MAX SIG WAVE HT (M)	MAX SIG WAVE HT (DA/HR)	SCALAR MEAN WIND SPEED (KNOTS)	PREV WIND (DIR)	MAX WIND (KTS)	MAX WIND (DA/HR)	MEAN PRESS (MB)
>	BURL1	28.9N	089.4W	0739	17.0					13.1	SE	30.4	08/10	1016.8
>	CARO3	43.3N	124.4W	0741	9.1					11.8	S	40.6	22/12	1011.9
>	CHLV2	36.9N	075.7W	0739	7.9					14.7	N	37.6	09/07	1019.6
>	CLKN7	34.6N	076.5W	0742	12.7					11.9	NE	34.7	09/09	1019.8
>	CSBF1	29.7N	085.4W	0742	16.9					6.8	E	24.9	08/13	1018.5
>	DBLN6	42.5N	079.4W	0740	2.0					9.6	SW	30.6	21/22	1019.6
>	DESW1	47.7N	124.5W	0741	8.1					15.0	SE	62.7	14/18	1011.0
>	DISW3	47.1N	090.7W	0738	-1.6					12.9	NE	35.9	05/20	
>	DPIA1	30.3N	088.1W	0741	16.3					13.0	E	32.0	09/04	1018.3
>	DRYF1	24.6N	082.9W	0736	22.1	22.7				10.8	E	28.5	09 13	1016.8
>	DSLN7	35.2N	075.3W	0739	12.3					20.0	N	44.7	09 01	1019.8
>	FBIS1	32.7N	079.9W	0739	14.4					9.3	E	26.2	18/17	1019.2
>	FFIA2	57.3N	133.6W	0742	2.8					14.2	N	34.4	16/19	1010.0
>	FPSN7	33.5N	077.6W	0725	15.4					15.7	N	35.7	08/20	1018.4
>	FWYF1	25.6N	080.1W	0683	22.7	23.9				14.8	E	31.7	08/17	1017.2
>	GDIL1	29.3N	090.0W	0737	17.6	19.0				11.7	E	32.3	08/05	1017.6
>	GLLN6	43.9N	076.5W	0740	0.7					10.3	S	27.3	08/05	1018.6
>	IOSN3	43.0N	070.6W	0731	2.1					12.1	S	30.2	10/00	1018.0
>	LKWF1	26.6N	080.0W	0740	21.8	23.5				12.9	E	27.1	10/07	1018.1
>	LONF1	24.9N	080.9W	0737	22.8	23.9				11.5	E	27.6	10/05	1016.9
>	MDRM1	44.0N	068.1W	0740	1.0					14.5	N	35.0	08/23	1017.7
>	MISM1	43.8N	068.9W	0738	1.0					14.3	N	33.7	06/10	1018.1
>	MLRF1	25.0N	080.4W	0742	22.9	24.2				13.3	E	29.8	13/02	1016.7
>	NWPO3	44.6N	124.1W	0738	8.9					11.0	E	41.3	09/21	1011.6
>	PILM4	48.2N	088.4W	0735	-2.9					12.4	NE	30.3	02/23	1021.6
>	PTAC1	39.0N	123.7W	0740	11.1					11.3	S	38.3	22/06	1014.8
>	PTAT2	27.8N	097.1W	0734	16.8	17.4				12.0	SE	32.0	07/19	1015.1
>	PTGC1	34.6N	120.7W	0737	13.4					14.0	N	39.8	10/19	1015.4
>	ROAM4	47.9N	089.3W	0734	-2.7									1021.0
>	SANF1	24.5N	081.9W	0743	22.7	23.9				12.3	E	28.8	10/09	1016.4
>	SAUF1	29.9N	081.3W	0739	17.0	15.9				10.2	N	27.5	02/10	1018.7
>	SBIO1	41.6N	082.8W	0736	2.6					10.0	NW	28.3	07/20	1020.8
>	SGNW3	43.8N	087.7W	0735	0.2					11.1	N	28.3	10/10	1021.5
>	SISW1	48.3N	122.9W	0739	7.6					11.4	SE	38.8	21/03	1011.8
>	SMKF1	24.6N	081.1W	0001	26.0	26.9				0.9	NW	0.9	31/23	1011.7
>	SPGF1	26.7N	079.0W	0739	22.1	24.1				10.0	E	25.4	13/04	1017.5
>	SRST2	29.7N	094.1W	0737	15.8					10.9	NE	25.4	08/02	1016.8
>	STDM4	47.2N	087.2W	0736	-1.4					15.8	NE	36.1	21/22	1020.3
>	SUPN6	44.5N	075.8W	0729	1.3	0.8				8.0	S	30.4	08/05	1019.3
>	SVLS1	32.0N	080.7W	0726	14.8	14.0				13.7	NE	33.0	09/10	1018.6
>	THIN6	44.3N	076.0W	0730	0.9									
	TPLM2	38.9N	076.4W	0738	7.2	6.1				10.7	NW	30.8	09/00	1019.6

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In the last issue, in the Lifelines column we failed to give credit for the Pt. Reyes Lighthouse photograph from Colin MacKenzie of the Nautical Research Centre, 335 Vallejo St., Petaluma, CA 94952. Instead of complaining, Colin mentioned that had he known it was a story about the lifesaving station, he would have sent some photographs of the boathouse and quarters. That is called killing us with kindness. He did include several pictures of the Pt. Reyes Lifesaving station, one of which is shown above. Thanks to a most gracious and helpful contributor to the Mariners Weather Log.

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